



280186

Third Five-Year Review Report

For

Arrowhead Refinery Site

Hermantown

St. Louis County, Minnesota

September, 2007

PREPARED BY

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Five-Year Review Report

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List of Acronyms

AIC	Adult Intake Concentration
ARAG	Arrowhead Remedial Action Group, the later PRP group in the mixed settlement Consent Decree
ARAR	Applicable or Relevant and Appropriate Requirement
AROD	Amended Record of Decision
ATSDR	Agency for Toxic Substances and Disease Registry
BaP	Benzo(a)pyrene
Barr	Barr Engineering Company
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
City	City of Hermantown
cPAH	Carcinogenic Polynuclear Aromatic Hydrocarbon
CW	City Well
DOC	Dissolved Organic Carbon
DRO	Diesel Range Organics
DRAP	Development Response Action Plan
FDI	Field Design Investigation
FS	Feasibility Study
FY	Fiscal Year
GAC	Granular Activated Carbon
GC	Gas Chromatograph
GC/MS	Gas Chromatograph / Mass Spectrophotometer
Gpm	Gallons per minute
GRO	Gasoline Range Organics
GW	Ground water
HBV	Health Based Value
HQ	Hazard Quotient
HRC	Hydrogen Release Compound
HRL	Health Risk Limit
HRS	Hazard Ranking System
IRIS	Integrated Risk Information System
LTRA	Long Term Response Action
MASC	Minnesota Arrowhead Site Committee, an early PRP group
MCLs	Maximum Contaminant Levels
MDH	Minnesota Department of Health
Mgd	Million Gallons per Day
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
MN	Minnesota
MnDOT	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
MW	Monitoring Well
NCP	National Contingency Plan

NPL	National Priority List
O&M	Operation and Maintenance
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PAHs	Polynuclear Aromatic Hydrocarbons
PLP	Permanent List of Priorities
ppb	parts per billion
ppm	parts per million
PRPs	Potentially Responsible Parties
PVOCs	Petroleum Volatile Organic Compounds
QAPP	Quality Assurance Project Plan
RA	Remedial Action
RAL	Recommended Allowable Limit
RAOs	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act of 1976
RD	Remedial Design
RI	Remedial Investigation
ROD	Record of Decision
RW	Recovery Well
SARA	Superfund Amendments and Reauthorization Act of 1986
SDWA	Safe Drinking Water Act
Site	Arrowhead Refinery Co. Site
SPM	State Project Manager
SQT	Sediment Quality Target
SRV	Soil Reference Value
STW	Short-Term Worker
SVES	Soil Vapor Extraction System
SVOCs	Semi-Volatile Organic Compounds
TAO	U.S. EPA Technical Assistance Office
TBC	To Be Considered (potential ARAR)
TCLP	Toxicity Characteristic Leaching Procedure
ug/L	Micrograms per Liter
USACE	United States Army Corps of Engineers
U.S. EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
WLSSD	Western Lake Superior Sanitary District

Executive Summary

The Site is located in T50N R15W, Section 4 in the east one-half of the southeast one-quarter, Hermantown, St. Louis County, Minnesota, eight miles northwest of the city of Duluth. The Site was used for re-tinning milk cans prior to 1945. The Site also may have been used as a dump and there may have been a gas station somewhere on the Site at one time. From 1945 to 1961, the property was used for recycling waste oil part-time. Arrowhead Refining Co. re-refined oil full-time until February 1977. The contamination with volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs), and heavy metals raised concerns for the safety of private drinking water wells in the area, direct contact and ingestion exposure, and environmental damage. There were three phases of site cleanup: the source material phase, the contaminated soils and sediments phase, and the ground water phase.

The remedial actions for the source materials, soil, and sediments consisted of excavation, treatment on-site and off-site disposal. The source materials were excavated in 1995 through 1996. Most source materials were liquefied and decanted, with the decanted liquid sold as off-spec fuels. Residuals from the liquefaction process and excavated materials that were not liquefied, were filtered and dried for lead reclamation or solidification/stabilization and placement in RCRA Subtitle D landfill. Contaminated soils and sediments were excavated in 1995 and 1996. Soils and sediment determined to be hazardous were treated on-site to stabilize them prior to off-site disposal. The groundwater remedy consisted of a watermain extension and residential user connections (construction completed in 1990) and a french drain from which contaminated groundwater was pumped to a publicly owned treatment works (POTW) (construction completed in 1993).

The groundwater remedy is currently in a trial shut-down with groundwater monitoring being conducted to document that clean up goals continue to be met. The site achieved construction completion with the signing of the Preliminary Closeout Report on December 19, 1996. This is the third five-year review for the Arrowhead Refinery Site. The trigger for this five-year review was the signature date of the second five-year review which was September 30, 2002. The assessment of this five-year review found that the remedy was constructed in accordance with the requirements of the Record of Decision (ROD) and the ROD Amendment.

The remedy for source materials, soil and sediments is expected to be or is protective of human health and the environment, and in the interim, exposure pathways that could result in unacceptable risks are being controlled. The remedy for groundwater currently protects human health and the environment because the remedial action objectives are being met at the site boundary and several institutional controls (ICs) are in place. However, in order for the remedy to be protective in the long-term, the following actions need to be taken. Trial shutdown ground water monitoring will be performed for several more years to verify that ground water cleanup goals have been achieved and protectiveness is maintained. Additionally, groundwater will be monitored to determine if surface water is being impacted at the site. Groundwater will also be monitored for contaminants which have potential new Applicable or Relevant and Appropriate Requirements (ARARs) and/or To Be Considereds (TBCs), and if exceedances of potential ARARs and TBCs are seen outside the site perimeter, the need for a new decision document (e.g., Explanation of Significant Differences [ESD] or ROD amendment) will be evaluated.

Finally, institutional controls (ICs) for the Site property and groundwater are required to ensure no inappropriate use of the Site or groundwater occur. Long-term protectiveness requires compliance with effective ICs. To ensure the remedy continues to function as designed, an IC plan will be prepared along with necessary corrective measures, so that long-term stewardship is ensured.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name (from WasteLAN): Arrowhead Refinery Company		
EPA ID (from WasteLAN): MND98082397		
Region: 5	State: MN	City/County: Hermantown, St. Louis County
SITE STATUS		
NPL status: <input checked="" type="checkbox"/> Final <input type="checkbox"/> Deleted <input type="checkbox"/> Other (specify)		
Remediation status (choose all that apply): <input type="checkbox"/> Under Construction <input checked="" type="checkbox"/> Operating <input checked="" type="checkbox"/> Complete		
Multiple OUs?* <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	Construction completion date: 12/19/1996	
Has site been put into reuse? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
REVIEW STATUS		
Lead agency: <input checked="" type="checkbox"/> EPA <input type="checkbox"/> State <input type="checkbox"/> Tribe <input type="checkbox"/> Other Federal Agency _____		
Author name: Jane Mosel/Mike Bares		
Author title: Project Manager and Project Hyrdogeologist (respectively)	Author affiliation: Minnesota Pollution Control Agency (MPCA)	
Review period:** 6/28/07 to 09/28/07		
Date(s) of site inspection: 7/25/07		
Type of review: <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <input checked="" type="checkbox"/> Post-SARA <input type="checkbox"/> Pre-SARA <input type="checkbox"/> NPL-Removal only </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <input type="checkbox"/> Non-NPL Remedial Action Site <input type="checkbox"/> NPL State/Tribe-lead </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <input type="checkbox"/> Regional Discretion </div>		
Review number: <input type="checkbox"/> 1 (first) <input type="checkbox"/> 2 (second) <input checked="" type="checkbox"/> 3 (third) <input type="checkbox"/> Other (specify) _____		
Triggering action: <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <input type="checkbox"/> Actual RA Onsite Construction at OU # _____ <input type="checkbox"/> Actual RA Start at OU# _____ </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <input type="checkbox"/> Construction Completion <input checked="" type="checkbox"/> Previous Five-Year Review Report </div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <input type="checkbox"/> Other (specify) </div>		
Triggering action date (from WasteLAN): 9/30/2002		
Due date (five years after triggering action date): 9/30/2007		

* ["OU" refers to operable unit.]

** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form, cont'd.

Issues:

- 1.) Groundwater and soil within the site boundaries are not remediated to unrestricted use/unlimited exposure (UU/UE). ICs are required to ensure the protectiveness of the remedy.
- 2.) Based on review of the ground water extraction system performance, cleanup goals have been achieved at the site perimeter compliance point. A few ground water standard exceedances are still periodically observed in on-site monitoring wells located in the historic source area. The MPCA has discontinued system operation, and a trial shut-down period has been initiated.
- 3.) There are potential new ARARs and TBCs for certain groundwater contaminants found in on-site monitoring wells (diesel range organics, 1,4-dioxane, vinyl chloride and arsenic) which have been established since the remedy was selected. These potential new ARARs and TBCs may raise a future protectiveness issue at the Site.
- 4.) A recent evaluation by MPCA has determined that diesel range organics (DRO) in on-site ground water has the potential to migrate from groundwater to surface water at concentrations of concern above a potential TBC.

Recommendations and Follow-up Actions:

- 1.) An IC plan is necessary to provide for the long-term effectiveness of the ICs which are already in place and to implement additional ICs.
- 2.) Groundwater performance monitoring during the trial shut down will be completed to verify groundwater clean up goals continue to be achieved at the site perimeter.
- 3.) Any analysis demonstrating exceedances of the new ARARs/TBCs outside the site boundary needs to be evaluated. If necessary, U. S. EPA will complete a formal decision making process (e.g., ROD amendment, ESD, etc.) in order to add additional ARARs and/or TBCs in order to make the remedy protective.
- 4.) The extent of DRO migration from groundwater to surface water will be monitored as a component of performance monitoring for the trial shut-down. If future analysis of surface water shows exceedances of the potential TBC level for DRO, additional evaluation will be needed. If necessary, U. S. EPA will complete a formal decision making process (e.g., ROD amendment, [ESD], etc.) in order to add the additional TBC in order to make the remedy protective.

Five-Year Review Summary Form, cont'd.

Protectiveness Statement:

The remedy for source materials, soil and sediments is expected to be or is protective of human health and the environment, and in the interim, exposure pathways that could result in unacceptable risks are being controlled. The remedy for groundwater currently protects human health and the environment because the remedial action objectives are being met at the site boundary and several ICs are in place. However, in order for the remedy to be protective in the long-term, the following actions need to be taken. Trial shutdown ground water monitoring will be performed for several more years to verify that ground water cleanup goals have been achieved and protectiveness is maintained. Additionally, groundwater will be monitored to determine if surface water is being impacted at the site. Groundwater will also be monitored for contaminants which have potential new Applicable, Relevant and Appropriate Requirements (ARARs) and/or To Be Considereds (TBCs), and if exceedances of potential ARARs and TBCs are seen outside the site perimeter, the need for a new decision document (e.g., [ESD} or ROD amendment) will be evaluated.

Finally, institutional controls (ICs) for the Site property and groundwater are required to ensure no inappropriate use of the Site or groundwater occur. Long-term protectiveness requires compliance with effective ICs. To ensure the remedy continues to function as designed, an IC plan will be prepared along with necessary corrective measures, so that long-term stewardship ensured.

Other Comments:

Date of last Regional review of Human Exposure Indicator (from WasteLAN): 9/25/2006

Human Exposure Survey Status (from WasteLAN): "Current human exposures are under control."

Date of last Regional review of Groundwater Migration Indicator (from WasteLAN): 6/7/2007

Groundwater Migration Survey Status (from WasteLAN): "Contaminated groundwater migration is under control."

Five-Year Review Report

I. Introduction

The purpose of the five-year review is to determine whether the remedy at the Arrowhead Refinery Superfund Site (Site) is protective of human health and the environment. As required, the methods, findings, and conclusions of the review are documented in this five-year review report. In addition, the five-year review report identifies issues found during the review and recommendations to address them. The report addresses all remedial action phases of the Site and the Site as a whole.

The MPCA, in cooperation with U.S. EPA, is preparing this five-year review pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) § 1211 and the National Contingency Plan (NCP). CERCLA § 121 states:

If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section (104) or (106), the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.

The U. S. EPA interpreted this requirement further in the NCP; 40 Code of Federal Regulations (CFR) § 300.430(f)(4)(ii) states:

If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.

The MPCA conducted the third five-year review of the remedy and remedial actions implemented at the Site in Hermantown, Minnesota. This review was conducted by the State Project Manager (SPM) and State Hydrogeologist for the entire Site from June 2007 through September 2007. This report documents the results of the review and the inspection conducted by the MPCA staff. U.S. EPA partially funded the work through a cooperative agreement.

The first and second Five-Year Reviews were conducted by the MPCA in 1997 and 2002, respectively. This is the third statutory five-year review for the Site. The triggering action for this review is the date of the previous Five-Year Review, which was September 30, 2002.

The statutory review is conducted because the hazardous substances, pollutants or contaminants remain at the site above criteria that allow for unlimited use and unrestricted exposure. The first five-year review primarily addressed the ground water remedial action while the second and third five-year reviews address all media phases and the Site as a whole.

II. Site Chronology

Table 1: Chronology of Site Events by Date

Site Event	Month/Day	Year
Initial discovery of problem or contamination: MPCA letter requiring improvement in waste disposal		1967
Pre-NPL MPCA order to discontinue disposal of wastes on the property		1976
Pre-NPL- U. S. EPA at MPCA request investigated environmental effects resulting from past disposal activities.		1979
Pre-NPL determination by U. S. EPA found a violation of Clean Water Act		1980
Pre-NPL action to construct ditch to divert surface water, fence		1980
Pre-NPL sampling 1981 to 1983		1981
NPL listing	October	1983
MPCA Permanent List of Priorities (PLP) listing	October	1984
Remedial Investigation/Feasibility Study (RI/FS) complete		1986
Public Health Assessment in RI/FS		1986
Record of Decision (ROD) U. S. EPA signature	September 30	1986
Remedial design start, Site pre-design field investigations, technology reviews, tests	March 31	1987
CERCLA Section 107 Suit, US District Court for costs	July	1989
CERCLA Section 106 Unilateral Administrative Orders to construct water main and groundwater extraction and treatment system	March	1990
Remedial Design (RD) start water main and connections		1990
RD complete water main and connections	December 31	1990
Remedial Action (RA) construction start for water main and connections	August 15	1990
RA Construction complete for water main and connections	December 31	1990
RD start for ground water extraction and treatment system	March	1990
RD complete ground water extraction and treatment system	May	1990
RA Construction start ground water extraction and treatment system	May	1990
RA Construction complete ground water extraction and treatment system	June 4	1993
Long-term Groundwater Response Action begins	July 30	1993
CERCLA Section 122(e) Special Notice letters to conduct the source material remedy	May	1990
CERCLA Section 106 Unilateral Administrative Orders to conduct the source material remedy	May	1991
RD start Source Materials	September 6,	1991
RD start Contaminated Soils and Sediments	September 6,	1991
RD start Contaminated Soils and Sediments		1994

Site Event	Month/Day	Year
ROD Amendment	February 9,	1994
RD complete Source Materials	January 10,	1995
Most recent Cooperative Agreement Amendment, for Long Term Remedial Action (LTRA)	February 14,	1995
Consent Decree	May 24,	1995
Construction start Source Materials	April 20,	1995
Most Recent Amended Superfund State Contract signature	July 22,	1996
Construction start Contaminated Soils and Sediments	January 25,	1996
Construction complete Contaminated Soils and Sediments	November 27,	1996
Construction complete Source Materials	December 31,	1996
Construction completion (Preliminary Close Out Report) date	December 19,	1996
First Five-Year Review	September	1997
Force Main ownership transfer from MPCA to Western Lake Superior Sanitary District (WLSSD)	March 25,	1999
Purchase of tax-forfeit parcels of the Site for redevelopment	February 26,	2002
Second Five Year Review	September	2002
Site enrolled in Voluntary Investigation and Cleanup (VIC) program to facilitate development by owners	October 13	2003
Updated Receptor Survey	December	2004
Direct Push Investigation (1,4-dioxane, arsenic, and DRO)	June	2005
MPCA internal assessment of surface water classification and ground water concentrations that are protective of surface water		2005
DRAP Approval	September 27	2006
Trial shutdown of ground water extraction and treatment system	March 22	2007
Site Inspection	July 25	2007

III. Background

Physical Characteristics

The Site is located in T50N R15W, Section 4 in the east one-half of the southeast one-quarter, Hermantown, St. Louis County, Minnesota, eight miles northwest of the city of Duluth (See Figure 1). Figure 2 is the map contained in the Consent Decree and it shows the legal descriptions. Of the area designated as the Site, about ten acres of concern on the Site are adjacent to the major State Highway 53 in Parcels B, B1, and B2. Figure 2 also shows county parcel numbers.

The original Site facilities were constructed in a white cedar swamp that was filled in when needed. The adjacent wetlands are ecologically sensitive with no known endangered species at or near the Site. The surface water formerly flowed southwest over the Site and discharged via a culvert under Highway 53 to a marshy area that joins Rocky Run Creek, a tributary of the Midway River. The Midway River ultimately discharges into the St. Louis River, which empties into Lake Superior. Minnesota has specific rules and policies for Lake Superior and its watershed, governing nondegradation, water quality criteria, and implementation procedures in support of federal Great Lakes laws and international agreements.

The Site is rural, with both residential and commercial development over time, with more populated areas within a few miles.

Land and Resource Use

The Site is on a major state highway, a good location for commercial development. The current and projected zoning and land use for the Site is restricted commercial/industrial. The land uses for the areas surrounding the Site are residential on the south and east sides of the Site, and restricted commercial/industrial on the Site and to the north. Future land use on the Site is expected to remain the same as at present, with increasing commercial development along the highway over time.

The Site use has been industrial/commercial since prior to 1945, with re-refining of used oil from 1945 until 1977. The Site soils have been cleaned up to a restricted commercial/industrial level and covered with top soil. An existing building is now used as a warehouse.

Ground water in the shallow outwash aquifer, commonly used for drinking water wells in the county, is currently used by three residences east of the Site on the opposite side of Lavaque Bypass Road. Other residences and businesses near the Site have been connected to municipal water. The drainage ditch at the site is an unlisted surface water. It is classified by default as a Class 2B, 3B, 4A, 4B, 5 and 6 water (Minnesota Rules, chapter 7050.0430), of which Class 2B is the most restrictive. Surface water use is ultimately governed by its final destination, Lake Superior, a protected water for multiple uses including drinking water and recreation.

History of Contamination

The Site was used for re-tinning milk cans prior to 1945. The Site also may have been used as a dump and there may have been a gas station somewhere on the Site at one time. No further information is available regarding the re-tinning business, the dump, or the gas station except that the dump was located south of the lagoon.

From 1945 to 1961, the property was used for recycling waste oil part-time. Arrowhead Refining Company re-refined oil full-time from 1961 until February 1977. The heavily contaminated areas were the two-acre sludge lagoon which together with the source materials totaled approximately 4,600 cubic yards and the process area with contaminated soil which, together with contaminated sediments in the wastewater ditch, totaled approximately 27,327 tons.

The Site is located along Highway 53 and is visually obvious. The contamination with volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs), and heavy metals raised concerns for the safety of private drinking water wells in the area, direct contact and ingestion exposure, and environmental damage.

Initial Response Pre-Record of Decision

In 1967, the MPCA staff sent a letter to Arrowhead Refining Company requiring improvements in waste disposal at the Site. The MPCA staff initiated a Site investigation in April 1976. After a 1976 MPCA order to discontinue dumping of sludge and clean up the Site, the Arrowhead Refinery Co. terminated operations in early 1977 with a declaration that they had no money for cleanup. From 1979 to 1984, the MPCA and the EPA investigated the extent, nature, and magnitude of contamination as well as identifying potential and actual impacts to receptors. Reports in 1979 and 1980 narrowed the extent of the contamination to the current ten acres of concern.

In 1980, the EPA determined that discharge from the Site violated provisions of the Clean Water Act. The U.S. Coast Guard dug a ditch on the north, east and south sides of the Site so that drainage and runoff was diverted around the drainage lagoon and facilities area. The ditch directed flow from the north side of the Site to the east, south along Lavaque Bypass Road, and then west along a drainage ditch north of Highway 53. The ditch ended at a culvert on the north side of Highway 53. Water flowed through the culvert to a wetland area south of the highway. The Site was also fenced in 1980.

Residential wells within a half-mile of the Site were sampled in 1981, 1982, and 1984 with no detections except one low-level hit of chloroform. The EPA believed that the chloroform detection was not Site-related.

The Site was included on the National Priorities List (NPL) in October 1983 with a score of 43.75, and on the state Permanent List of Priorities in October 1984.

The remedial investigation (RI) report and feasibility study (FS) were completed in 1986. A public health assessment was completed in 1986. The EPA signed the ROD for the Site on September 30, 1986.

Basis for Taking Action

The media that were contaminated included soils, sediments and ground water. The 1986 RI Report included a public health evaluation. Remedial actions were required for ground water, soil, sediments and sludge for the following reasons:

- The acid sludge lagoon was a PAHs, VOCs, and heavy metals (primarily lead) source for future soil and water releases and possible air releases, as well as a direct contact threat for acid burns and contaminant exposure, and it was causing obvious environmental damage including trapping birds and animals in the tarry substance;
- Leaching of contaminants to ground water caused drinking water standards and criteria to be exceeded. Specifically, carcinogenic PAHs in some ground water samples exceeded the 10^{-6} (1 in 1,000,000) excess lifetime cancer risk. Concentrations of some non-carcinogens including cadmium, lead, and manganese also posed risks.
- Soil exposure resulted in excess lifetime cancer risks for both commercial and residential use. Estimated intakes of some non-carcinogens (e.g. lead, cadmium, xylene, and barium) exceeded the acceptable intake criteria;
- Potential impacts to down-gradient off-site private wells might have occurred through contaminated ground water migrating across the Arrowhead Refinery Company property boundary and Highway 53. Estimated arrival times to two private wells south of Highway 53 was between 15 and 40 years.

Future use of these private wells may have posed risks in excess of 10^{-4} (1 in 10,000) lifetime cancer risks.

IV. Remedial Actions

At the Site, there are three phases: the source material phase, the contaminated soils and sediments phase, and the ground water phase.

Remedy Selection

Remedial Action Objectives

In 1990, the MPCA staff's Response Action Plan itemized the following remedial action objectives (RAOs):

1. Reduce releases of pollutants or contaminants or hazardous substances from the sludge lagoon, soils, peat and sediments at the Site into the ground water and/or surface waters of the State.
2. Reduce public health and environmental threats posed by the sludge lagoon at the Site due to direct contact through touch or ingestion.
3. Reduce public health and environmental threats posed by the ingestion, inhalation, absorption, and migration of the pollutants or contaminants or hazardous substances contained in the sludge, soils, peat and sediments at the Site.
4. Reduce concentrations of pollutants or contaminants or hazardous substances from the ground water and surface water beneath, at, or adjacent to, the Site.

On September 30, 1986, EPA signed a ROD for the Site. The ROD specified:

- ◆ excavation and thermal treatment of sludge, oil saturated peat, filter cake, with leachate and air emissions control, and disposal of ash on-site if non-hazardous;
- ◆ excavation and thermal treatment of contaminated soil and sediments which exceed the 10^{-6} excess lifetime cancer risk level and adult chronic acceptable intake Adult Intake Concentration (AIC) levels, and disposal of ash on-site if non-hazardous;
- ◆ extraction and treatment of contaminated ground water, with a French Drain and extraction wells at 45 gallons per minute (gpm), and with treatment either on-site or off-site without pretreatment to WLSSD sanitary sewer;
- ◆ construction of ground water monitoring wells and implementation of a long-term ground water monitoring program;
- ◆ extension of municipal water supply water main and connections to potential receptors, and no further use of private wells by these residents; and
- ◆ design investigations.

MPCA concurred with the 1986 ROD with the provision that other alternatives be evaluated during the design investigations. This evaluation occurred in several design studies, and in 1994, EPA issued a ROD amendment (AROD) to change the remedy for the source material phase and the contaminated soils and sediments phase to:

- ◆ Excavation of sludge and filter cake using a visually contaminated standard with an estimated volume of 4,600 to 6,100 cubic yards;

- ◆ On-site treatment of sludge and filter cake by chemical disassociation (re-refining) of the toxic compounds within the sludge/filter cake matrix to produce a saleable off-specification fuel and to recover lead in a smelting operation or to stabilize and place in a permitted RCRA Subtitle D facility; and
- ◆ Excavation of visually contaminated soils and sediments, treatment by stabilization of lead, followed by placement in a permitted RCRA Subtitle D facility.

The ground water remedy did not change in the 1994 AROD. However, the clean-up criteria was changed from 10^{-6} excess lifetime cancer risk to the MCLs, and the compliance point was determined to be the Site perimeter.

Remedy Implementation

Source Material Areas and Soils and Sediments Phases

A Fieldwork Design Investigation (FDI) was completed by EPA's contractor, CH2M Hill. The report, submitted on May 1, 1990, indicated additional contaminated soils were present. After more fieldwork, the final estimate of contaminated soil was set at 27,000 cubic yards.

Because of the major increase of contaminated soil discovered during the FDI, several additional treatability studies were conducted to find a less expensive alternative to incineration, as specified in the 1986 ROD. The treatability studies included:

- A 1989 solvent extraction treatability study for the source material and contaminated soils by CH2M Hill on behalf of EPA;
- A 1991 bench scale biotreatability study conducted by the MPCA staff, which found that the organic contamination in Site soils may be treated through a slurry phase process; and
- A 1993 solid waste composting process study conducted by the Minnesota Arrowhead Site Committee (MASC), the group of potentially responsible parties (PRPs) at the Site. The study was successful for destroying VOCs and 3- and 4-ringed noncarcinogenic PAHs in soil and source material. It was questionable if the 5- and 6-ringed PAHs would be remediated. Other problems identified included being less successful at bioremediating the source material, a substantial increase in volume, and liberation of lead found in the oily matrix.

While the treatment technologies described above ultimately proved not to be viable, the studies conducted using these treatment technologies did lead to the discovery that carcinogenic PAH and VOC levels in soil and sediment samples were all beneath health based levels of concern. As a result, lead was the only contaminant of concern for soil and sediments considered in the 1994 amended ROD. In 1992, MPCA staff conducted a soil washing and lead removal treatability study. This technology also did not prove to be viable. Since organics no longer were of concern, U. S. EPA and MPCA staff agreed to amend the soil and sediment remedy from on-site incineration to excavation and placement in a Subtitle D landfill. MPCA staff also stated a preference for treatment remedy prior to disposal.

In late 1992 through early 1993, MASC explored using thermal treatment pursuant to the original remedy for the source material. This alternative also was unsatisfactory.

In spring 1993, MASC learned of proprietary reprocessing/re-refining technology developed and marketed by 7&7, Inc. In spring 1993, the EPA conducted a treatability study and demonstrated that this technology worked well for the source material. The reprocessing/re-refining technology employed by 7&7, Inc. involves liquification, flocculation, separation, and filtration. Lead and other metals in the source material are separated out leaving a low lead content off-specification fuel. Lead-rich filter cakes are recovered for use or stabilized and placed in a landfill.

Based on the results summarized above, the remedy was modified in the 1994 AROD by the U. S. EPA to be the 7&7, Inc. excavation and re-refining/re-processing described above. As a result of court action, the potential responsible parties MPCA and U. S. EPA signed a Consent Decree in 1995 for implementation of the AROD.

Documentation of the completion of the source material and soil and sediment excavation, treatment and disposal response actions are found in the reports:

“Completion of Remedial Action Report, Completion of Work Report for the Arrowhead Refinery Site, December 23, 1996” by 7-7, Inc. and SERVICE Environmental Engineering (PRP contractors), and

“Phase I Residuals, Phase II Contaminated Soils And Sediments, Remedial Action Closure Report, Arrowhead Refinery Site, Hermantown, Minnesota, November 1996” by CH2M Hill (EPA’s contractor).

Remediation of the source materials, soil and sediment and ground water are discussed below.

Source Material; (Phase I)

The Arrowhead Refinery Assessment Group (ARAG), successor to the MASC group of PRPs, was formed to be the response group in the mixed-funding settlement in the judicial Consent Decree. ARAG conducted the source material remedy except for residuals stabilization and disposal which was performed by U.S. EPA. The Arrowhead Refinery historically had re-refined oil by extracting moisture and impurities. The re-refining process consisted of using an acid-clay process. Three waste streams were produced: an acidic sludge that contained metals and was disposed in a wetland that became a sludge lagoon; a filter cake that was disposed over the native peat in the wetland so additional processing area was created; and waste water that was discharged to the wastewater ditch. The contractor, 7-7, Inc. was hired by ARAG to excavate the sludge, filter cake, and oil-saturated peat and re-refine the oil. The sludge was black with a tar-like consistency and it consisted of wastes derived from the treatment of the waste oil with sulfuric acid. The filter cake consisted of clay saturated with oil. Originally, it had accumulated on the plates of the filter press.

The February 1994 AROD specifically required that all visibly contaminated source material be excavated, liquified, neutralized, and homogenized with dilutant and neutralizing agents on-site in the areas of the sludge lagoon, the process area, and the wastewater ditch. The material was then to be conditioned with a precipitating agent, clarified, and the decant liquid was to be offered for sale as off-spec fuel. The solids were to be filtered and dried to stabilization and disposed off-site in a Resource Conservation and Recovery Act (RCRA) Subtitle D landfill.

Contract change orders were executed in early 1996 to direct on-site contractors not to liquefy filter cake to extract off-spec fuel, but to proceed directly to filtering, drying and stabilization of the filter cake prior to off-site disposal. Another change was made in March 1996 directing on-site contractors to stabilize filter cake after filtering, but without drying. In 1995 and 1996, the contractor, 7-7, Inc. excavated 7,025.8 tons of Source Material, 5,334.0 cubic yards of hazardous debris and 843 tons of non-hazardous debris. A total of 4,614.7 of the 7,025.8 tons were handled through the liquefier (re-refining) process to yield 1,002,127 gallons of Fuel Product. The remaining source material consisted of 196.5 tons of filtercake that was screened and dried, and 2,214.6 tons of filtercake that was screened according to EPA’s approvals. ARAG’s contractor prepared a Completion of Remedial Action Completion of Work Report for Phase I source excavation, liquefaction, filtering and drying. U. S. EPA’s contractor, CH2M Hill, prepared the Closure Report for Phase I residuals and Phase II contaminated soils and sediments. Because U. S. EPA’s contractor, GNB, stabilized source materials residuals and processed contaminated soils and sediments, much coordination and negotiation occurred between U. S. EPA and ARAG to accomplish the cleanup.

A total of 4,072 tons of source materials requiring stabilization, and 532 tons of materials that did not require stabilization by a proprietary chemical lead stabilizing agent were disposed in off-site Subtitle D landfills. The ARAG disposed of source materials at the Lake Area Landfill for Phase 1, and U. S. EPA disposed of contaminated soils at Elk River Landfill for Phase 2; both had lined cells in which the materials were placed. Some debris, consisting of tree stumps, branches, peat, tires, soil and other miscellaneous material, was tested as hazardous and others were not hazardous, but all materials were sent to the appropriate type of facility (Subtitle C or D).

Soils and Sediments; (Phase 2)

U. S. EPA was responsible for the soils and sediments Phase 2 work. Soils and sediments above 500 mg/kg lead or visibly stained or discolored were excavated, treated on-site by a proprietary chemical lead-stabilizing agent, and disposed. Once all excavation was completed, a visual verification was conducted. If there was a question about whether material was source material, a sample was collected for Toxicity Characteristic Leaching Procedure (TCLP) testing for lead or for carcinogenic PAH analysis. Five such samples were collected and were found not to be source materials (i.e. TCLP lead results <5 milligrams per liter (mg/L); total carcinogenic PAHs < 57 parts per million (ppm) and individual cPAHs < 5.7 ppm. Once all excavation was complete, photographs were taken and the excavated locations were visually inspected for any discoloration or staining indicating organic contamination. In addition to visual verification for organics, CH2M Hill collected verification samples on roughly 70-foot centers and analyzed these samples for lead. No lead concentrations exceeded 500 milligrams per kilogram (mg/kg) and the average remaining lead content of the soils underlying the former sludge lagoon was 56 ppm.

In general, visibly contaminated soils were underlain by a blue-gray clay layer, which appeared to have acted as a barrier to further contaminant [downward] migration. A total of 456 tons of contaminated soils was excavated from beneath the former sludge lagoon during Phase 1 (Residuals RA). A total of 24,327 tons of contaminated soils were disposed during Phase 2 (Contaminated Soils and Sediments RA) including the wastewater ditch sediments. A total of 48,050 tons of backfill was placed over the remaining soils and the wastewater ditch was completely filled in. The backfill for the cover was tested and met unrestricted use standards for lead, (<100 mg/kg), carcinogenic PAHs (<1 mg/kg), and gasoline range organics (GRO)/petroleum volatile organic compounds (PVOC) (<10 mg/kg). The backfill was covered by 4 to 6 inches of topsoil and seeded. The final grade was sloped slightly to the southwestern part of the Site. Other cleanup activities during source and soils and sediments excavation included:

- Fence-line air quality monitoring;
- Monitoring well abandonment in the excavation areas;
- Disposal of 161 drums with investigation-derived waste remaining from several investigations conducted at the Site and 26 drums and pails from the Gopher Oil building;
- Sampling and ensuring that decontamination water, ground water, and storm water generated during the Remedial Action met discharge standards prior to discharge to the WLSSD sanitary sewer;
- Disposal of one open-top railroad car with heating coils. The railroad car contained oil saturated sand;
- Demolition of most on-site buildings and a determination that there was no asbestos in the buildings; and
- Underground storage tank disposal.

Ground Water Phase

The PRP group completed the construction associated with the ground water remedy (including water main extension and connection and construction of a groundwater extraction and treatment system) pursuant to the March 1990 UAO. During the 1990 construction season, the Hermantown water main extension and connections were completed. The water main extension ran 3,300 feet from a tie-in at the corner of Highway 53 and Lavaque Bypass (formerly Ugstad Road). In all, 13 residences and businesses were connected to the water main. Following connection to Hermantown city water, 10 private wells were sealed.

Construction of the ground water extraction and treatment system was completed on June 4, 1993. A ground water extraction system that consisted of a French Drain with four manholes and sumps was fully installed with discharge to the WLSSD treatment facility. A year later, the U. S. EPA and MPCA determined the ground water phase remedy was fully operational and functional, pursuant to 40 CFR 300.435(f)(2). The installed system, commonly known as a "French Drain", was designed to remove contaminated ground water prior to discharge to the WLSSD force main, and to prevent contamination movement beyond Site boundaries.

The purpose of the ground water extraction system was to remediate the ground water to MCLs and to prevent the off-site migration of contaminated ground water. In addition, the homes on Rose Road, south of Highway 53 adjoining the south side (down-gradient side) of the Arrowhead Refinery Site were hooked up to city water. In 2004, an updated receptor survey was performed at the Site (Updated Receptor Survey, Bay West, January 2005). Properties within 1,500 feet west of the Site's western property line, properties within 1,500 feet south of the Site's southern property line/Miller Trunk Highway (US Highway 53), and properties immediately east of the site were investigated as part of the survey. A total of 10 water supply wells were identified during the survey. Two of the wells were included in the sampling plan for performance monitoring associated with the Trial Ground Water Extraction System Shut-Down Report (Bay West, 2007). During the baseline monitoring event, it was determined that one of the two wells has been sealed since the 2004 receptor survey.

Implementation of Institutional Controls and Other Measures

Institutional controls (ICs) are required to ensure the protectiveness of the remedy. The institutional control contained in the AROD states: "Place deed restrictions on-site to ensure that the site remains zoned for commercial/industrial development only." ICs are non-engineered instruments, such as administrative and legal controls that help to minimize the potential for exposure to contamination and that protect the integrity of the remedy. ICs are required to assure the long-term protectiveness for any areas which do not allow for unlimited use or unrestricted exposure (UU/UE). The table below summarizes institutional controls for these restricted areas.

Table 2 : Institutional Controls Summary Table

Media, Engineered Controls, & Areas that Do Not Support UU/UE Based on Current Conditions.	IC Objective	Title of Institutional Control Instrument Implemented (note if planned)
On-Site Groundwater – The ARARs for the contaminants of concern have been met at the Site boundary and the groundwater extraction and treatment system has been turned off on a pilot basis. The ARAR for one contaminant of concern (arsenic) is not being met at two on-site monitoring wells.	Restrict use of groundwater on-site.	(1) commercial/industrial zoning (completed); (2) DRAP (completed) (3) environmental covenant (planned) and (4) notice (record Consent Decree/access agreements) (planned).

On-Site Soils – Area cleaned up to commercial/industrial standards	Restrict residential use of on-site property. Prohibit disturbance of soils .	(1) commercial/industrial zoning (completed); (2) DRAP (completed); (3) environmental covenant (planned) and (4) notice (record Consent Decree/access agreements) (planned).
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Maps which depict the current conditions of the site and areas which do not allow for UU/UE will be developed (paper and GIS versions) as part of the IC Plan.

At this time, initial IC evaluation activities have determined that some ICs have been implemented for the on-site groundwater and soils but other ICs have not been implemented. The two ICs which have been implemented are the commercial/industrial zoning and the Development Response Action Plan (DRAP). Two additional ICs are planned which are an environmental covenant (MPCA has drafted a restrictive covenant, but the Minnesota Uniform Covenants Act recently passed and should be followed) and notice (recording Consent Decree/access agreements).

The objective of these ICs is to prevent residential development and use of the contaminated groundwater and or exposure to residual soil contamination at the site. The local zoning for industrial/restricted commercial use is in place and prohibits residential use of the property. Based on inspections and communications with the site developer, MPCA/U.S. EPA are not aware of site or media uses which are inconsistent with the stated objectives of the ICs.

An IC Plan will be developed by MPCA/U.S. EPA within six months of this five-year review to review the effectiveness of the existing ICs, and to plan for additional ICs and for long-term Site stewardship. The IC Plan will plan for IC evaluation activities such as mapping of ICs and an evaluation of the property title to determine whether some interest, such as a mortgage or utility easement, might defeat the efficacy of the institutional controls. In the event that the trial groundwater extraction system shutdown is resulting on contaminants migrating off-site, the IC Plan should include an evaluation of ICs which would prevent use of the contaminated groundwater which has migrated off-site.

Long term protectiveness at the site requires compliance with use restrictions to assure the remedy continues to function as intended. To assure proper maintenance and monitoring of effective ICs, long-term stewardship procedures will be reviewed and a plan developed (new plan or modification to the O&M Plan). The plan would include regular inspection of ICs at the site and annual certification to U.S. EPA that ICs are in place and effective. Additionally, use of a one-call system should be explored for long-term stewardship.

System Operation/Operation and Maintenance

System operations consist of a French Drain with a pump out system and discharge to the WLSSD sanitary sewer without treatment. The MPCA assumed responsibility from the PRPs for the ground water extraction system in July 1995. Since then, the MPCA's contractors have made weekly Site visits to perform regular maintenance and data collection, such as pump running time, flow totalizer readings, and discharge volume to the force main. An inspection of the French Drain and associated mechanical equipment occurs quarterly, along with groundwater elevation measurements. Discharge samples are collected in accordance with WLSSD permit requirements. The entire Site is inspected on a quarterly basis, including the physical condition of all equipment, monitoring wells and the land use. The O&M Manual is available, however it has been updated by the Annual Reports, more recent Quality Assurance Project Plans (QAPPs), and Site safety plans.

The ground water extraction system was turned off by the Western Lake Superior Sanitary District (WLSSD) on March 22, 2007 to allow the WLSSD to conduct testing and repairs of the forced main. While performing this work, the WLSSD determined three check valves associated with the Arrowhead ground water extraction system did not seal properly when the Arrowhead extraction pumps were not operating. At approximately the same time, the MPCA was reviewing the draft Trial Ground Water Extraction System Shut-Down Report. The report was approved for implementation at approximately the same time the WLSSD determined the check valves had failed. As such, the ground water extraction system was left off and the trial shut-down was initiated.

Historically, monitoring wells have been sampled on a semi-annual basis. The number of monitoring wells in the monitoring network has varied during the five-year review period, ranging from 18 to 27. During the trial system shutdown, ground water monitoring is continuing at 18 locations including 13 monitoring wells, including one residential well and the four manholes associated with the French drain. During the trial shut-down, ground water monitoring will be performed quarterly for at least one year to monitor for possible rebound and/or plume migration. After this time, the ground water monitoring program will be reassessed. It should be noted that check valves in the pump control house leak and will require replacement if the groundwater extraction system is returned to operation.

The 1986 ROD estimated annual O&M costs for the ground water extraction and treatment system to be \$130,000 to \$180,000 for 25 to 50 years. The 1994 AROD did not further address costs. MPCA's actual annual O&M costs for the last MPCA fiscal year 2007 (July 1, 2006 through June 30, 2007) is the most recent year for which cost data is available. The MPCA's annual O&M costs during this time period were approximately \$95,000.

V. Progress Since the Last Review

This is the third five-year review for the Arrowhead Refinery Site. The second five-year review was completed and signed on September 30, 2002. Recommendations and follow-up actions from the 2002 five-year review are as shown in Table 3 below:

Table 3: Recommendations and Follow-up Actions Taken Since the Last Five-Year Review

Issues from Previous Review	Recommendations/ Follow-up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
1. Consent Decree, restrictions, and access agreements are not filed at the Recorder's office.	Assure Consent Decree is filed; assure access for MPCA staff; determine which parcels need restrictions, finalize restrictions, file restrictive covenant.	MPCA	December, 2003	Not yet complete-see Section IX of this report Recommendations and Follow-Up Actions	Not completed
2. Settlement and drainage	Evaluate and if necessary: a.) Bring settled areas to final grade. b.) Prepare a drainage plan. c.) Repair the plugged culvert north of Highway 53	MPCA/EPA	December 2004	Recommendations addressed by approved DRAP. Culvert Repaired.	2003 (c) Jan 2005 (a and b)

Issues from Previous Review	Recommendations/ Follow-up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
3. Potential impact to biota in sediments.	Sample sediments to determine the potential impact to aquatic organisms from lead in sediments above the 130 mg/kg Tier 2 Sediment Quality Target (SQT) sediment screening levels in the EPA ditch south of the Gopher Oil Building and downstream from it to the culvert north of Highway 53.	EPA/ MPCA	December 2004	Sediments were removed in 2003, eliminating the potential impact to biota.	2003
4. Lack of confirmatory ground water sampling	Perform confirmatory sampling for arsenic, hexavalent chromium, zinc, vanadium, from well MPCA-4A and the extraction system discharge, zinc from MPCA-14S, and 4-methylphenol (SVOCs) from wells MPCA-4A, MPCA-5A, MW-3S, MW-14A, and the extraction system discharge, compare with the current standards and numbers.	MPCA	December 2004	Completed - No additional sampling necessary for hexavalent chromium, zinc, vanadium or 4-methylphenol is necessary or required because concentrations were below cleanup goals. Arsenic will continue to be sampled at select locations during the trial shut-down	2005 (arsenic monitoring ongoing)
5. Sporadic total lead exceedances in the discharge of the 15 ug/L at the tap number may indicate migration with ground water.	Collect four consecutive quarters of dissolved and total lead discharge samples to show lead is not in dissolved sample.	MPCA	2004	Completed - Four quarters of dissolved and total lead were collected at select locations. The highest dissolved lead results detected were approximately one order of magnitude less than the EPA action level of 15 µg/L at the tap. No additional lead sampling is necessary or required.	2005

Issues from Previous Review	Recommendations/ Follow-up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
6. 1,4-dioxane has a revised groundwater standard (HBV of 30 ug/L).	Ground water sampling of source area (on-site) wells and the extraction system discharge for 1,4-dioxane to determine if any concentrations exceed the HBV of 30 ug/L.	MPCA	October 2002	Completed - Analytical results near or above HBV at some locations. Continue to sample at select locations during trial shut-down	Initial results 2003 (1,4-dioxane monitoring ongoing)

Table 4 summarizes additional actions taken since the last five-year review, either to specifically address the recommendations in Table 3 or otherwise conduct system operation and monitoring at the site.

Table 4: Other Actions Taken Since the Last Five-Year Review

Other Issues	Recommendations/ Follow-up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
Monitoring Well repairs and abandonment	Repair damaged wells and abandon wells no longer required for monitoring	MPCA	None	Well repairs and abandonment completed	2007 (well repair ongoing as needed)
Trial Groundwater Extraction System Shut-Down Report and Implementation	Shut down of system in 2007 based on recommendations in Report (See Section VI. for further information.)	MPCA	Previous five-year review anticipated shutdown by 2007	System shut down and post-shutdown monitoring initiated. See discussion in Section IX- Recommendations of this report.	March 2007
Re-evaluate ground water monitoring program	Reduction in analytes in the GW monitoring program	MPCA	None	GRO removed in 2007. Wells and parameters reduced after completion of recommendation in 2002 Five-Year Review.	2007
Updated Receptor Survey	Update original receptor survey with more current information	MPCA	Recommended in 2003 Annual Report	Contact property owners and search databases	December 2004 (report January 2005)
DRAP submittal, approval, and Implementation	Ensure site development is conducted in accordance with use restrictions	Property Owners/ MPCA	None	DRAP submitted and approved by MPCA	DRAP dated 7/12/06, approved 9/27/06

Other Issues	Recommendations/ Follow-up Actions	Party Responsible	Milestone Date	Action Taken and Outcome	Date of Action
GW to surface water protectiveness assessment	Determine if any contaminants are likely to move from ground water to surface water. If so, monitor for levels which may affect protectiveness of the remedy	MPCA	None	See discussion in Section IX- Recommendations of this report	See discussion in Section IX- Recommendation of this report
Direct Push Investigation	Further delineate 1,4-dioxane, arsenic, and diesel range organics in soil and ground water in the historic source area.	MPCA	None	Investigation Completed	Document ed in December 2006 report
Semi-Annual GW Monitoring and Annual Reporting	Conduct ongoing ground water monitoring, system operation, and reporting	MPCA	Ongoing	Annual reporting of semiannual monitoring and system performance	2002 through 2006

For more information on these additional actions, see Section VI (Data Review) and Section VII. Technical Assessment, Question A and Question B of this report.

VI. Five-Year Review Process

Potentially interested parties including MPCA and EPA management and staff counterparts were notified of the start of five-year review. The members of the review team included:

- ◆ MPCA Site Project Manager: Jane Mosel
- ◆ MPCA Hydrogeologist: Mike Bares
- ◆ Consultant: Bay West: Paul Walz
- ◆ MPCA Public Information Officer: Anne Perry-Moore
- ◆ EPA Remedial Project Manager: Darryl Owens
- ◆ Minnesota Department of Health Human Health Risk Assessor: Carl Herbrandson
- ◆ Ecological Risk Assessor: Steve Hennes
- ◆ MPCA Human Health Risk Assessor: Emily Hansen

A review schedule which addressed the following components of the five-year review was developed for June through September 2007:

Community Involvement,
Document review,
Data Review,
Interviews,
Site Inspection,
Five-Year Review Report Development and

Five-Year Review Report Reviews.

Community Notification and Involvement

The community was notified via a news release. A copy of the news release is provided in Attachment 2. As of the date of this report, the MPCA has not received any calls or written comments from the public about the Site.

Document Review

Documents reviewed for this five-year review are referenced in Attachment 3. The applicable or relevant and appropriate requirements (ARARs) and to be considered (TBC) policies and guidance documents, as listed in the 1986 ROD and in the 1994 AROD, were also reviewed.

Data Review

Source Material, Soils and Sediments

Soil sampling during this time was limited to a direct push investigation performed in June 2005 to assess the potential for an ongoing arsenic, DRO and 1,4-dioxane source(s) in the historic source area. Only DRO and arsenic were detected in soil samples collected during the investigation. Development activities have added several feet of clean fill from off-site sources to much of the site. This additional soil increases the protectiveness and the potential for exposure to native soil is reduced. Further, the arsenic and DRO concentrations detected in soils were determined not to be elevated enough to have the potential of being a continuing source of contamination to ground water.

Groundwater

In this document, the ground water extraction system will be evaluated in three ways: 1) mechanical performance and reliability of the ground water extraction system; 2) hydraulic containment; and 3) ground water cleanup. Ground water data was reviewed since the second five-year review in 2002 until October 2006, the last ground water monitoring event before the trial ground water extraction system shut-down was implemented. A discussion regarding compliance with WLSSD discharge requirements is also included.

Mechanical Performance

The system operated without any equipment failures during 2003 through 2007 when the trial shutdown began, and no major maintenance activities were performed during the reporting period. While ground water extraction equipment operated reliably during the reporting period, the electric heater in the control house failed in 2005. The electric heater and the circuit breaker for the electric heater were both replaced by Bay West in the fall of 2005. The ground water extraction system was turned off on March 22, 2007, to allow the WLSSD to conduct testing and repairs of the forced main. While performing this work, the WLSSD determined three check valves associated with the Arrowhead ground water extraction system did not seal properly when the Arrowhead extraction pumps were not operating.

Operation of the ground water extraction system maintains a consistent water elevation in the French Drain. Pumping rates vary seasonally and with precipitation. Monthly monitoring of discharge volumes is required by WLSSD. Ground water discharge volumes for the ground water extraction system are in the annual monitoring reports. With a few exceptions, the discharge volume has been fairly consistent for the past five years, ranging between approximately 500,000 gallons during low flow months to 1.4 million gallons in high flow per months. Refer to the annual reports for additional information.

A summary of monitoring results of the contaminant concentrations from the ground water discharge is provided in the Annual Reports. The WLSSD allowed limits are: cis-1,2-dichloroethene 1,000 ug/L;

trans-1,2-dichloroethene 1,000 ug/L; trichloroethene 1,000 ug/L; vinyl chloride 1,000 ug/L; total VOCs, 3,000 ug/L; Gasoline Range Organics (GRO) 100,000 ug/L; Diesel Range Organics (DRO) 100,000 ug/L; and total lead 3,000 ug/L. No single chlorinated VOC or total VOCs have exceeded these allowed limits in the past five years. GRO and DRO have generally been below the reporting limit during this 5 year period, but the GRO concentration was 680 ug/L in November 2002, and the DRO concentration was 5400 ug/L in October 2003. Although these values were within the discharge limits, they prompted additional soil and ground water sampling for DRO as detailed in the 1,4-Dioxane, Arsenic and DRO Direct Push Investigation Report (Bay West, 2006). Total lead was only sporadically detected and at very low concentrations of up to 10.2 ug/L during this five-year period.

Hydraulic Containment

The first five-year review indicated that ground water flow direction at the Site, prior to construction and operation of the French Drain, was southwesterly in the northern portion of the Site and more westerly in the southern portion of the Site.

From June 1993 to spring of 1997, a ground water elevation of 1405 feet elevation was maintained in the French Drain. For further information, refer to the first five-year review.

During the first five-year review process, the ground water capture zone was found to be more than adequate across the Site. As a result, a decision was made to raise the ground water elevation in the French Drain from 1405 feet to 1407 feet elevation. The higher discharge rate that resulted from the 1405 feet elevation was no longer necessary as the source material remediation activity was completed and dewatering for excavation operations was no longer necessary. The adjustment to an elevation of 1407 feet was completed in May 1997. A May 1997 water table contour map for the Site from the first five-year review shows that an adequate zone of capture across the Site was maintained. See attached figure 3. Ground water flow directions remained consistent with previously observed flow directions.

From May 1997 until March 2007, the ground water containment system continued to be operated effectively at the 1407 foot ground water elevation in the French Drain, with few exceptions. The ground water elevations in one or more drain system man holes exceeded the specified target level of 1407 feet above mean sea level (feet MSL) for hydraulic containment during quarterly gauging events in February, April, and July 29, 2003, January 2004, and May 2006. In the last two cases, the elevations were only slightly (less than 0.2 feet) above the target level. Ground water contour maps and a discussion of the capture zone for each gauging event are included in the Annual Reports.

Ground Water Analytical Evaluation

Historically, many of the on-site ground water monitoring wells had significant exceedances of federal Maximum Contaminant Levels (MCLs), while the concentrations in down-gradient off-site monitoring wells have been limited to detections below the MCLs on an infrequent basis. The on-site monitoring wells that have historically shown MCL exceedances include well locations MPCA-4, MPCA-5, and MW-14.

In December 1994, the MDH began to promulgate Health Risk Limits (HRLs) for many compounds. Subsequently, the MDH began to develop Health Based Values (HBVs) for other compounds, which may be promulgated in the future. Both HRLs and HBVs are based on carcinogenic and/or hazard index properties, and the MPCA uses these numbers to make decisions. For some chemicals of concern, the MDH has established risk-based criteria more stringent than MCLs. For example, the MDH HRL for vinyl chloride (0.2 µg/L) is a factor of 10 less than the MCL (2.0 µg/L). Under a draft rule presently being considered, the vinyl chloride HRL would be further reduced to 0.08 µg/L.

Some analytes for which the MDH has established a HBV do not have a MCL. Two examples are 1,4-dioxane and diesel range organics values (DRO) at this site which have HBVs of 30 µg/L and 200 µg/L,

respectively. For analytes that have more conservative MDH-developed criteria than the MCLs, the MPCA has historically compared extraction system discharge and ground water concentrations to the more conservative criteria, as a matter of policy. A summary of the current MCLs and other standards, including the legally promulgated HRLs and the advisory HBVs, are provided for analytes detected in ground water during the five-year period covered by this review has been prepared and is presented in Section VII.- Table 6 of this report. For ground water, only the MCL for arsenic has significantly affected ground water clean-up at the Site during the current five-year review period. Although 1,4-dioxane and DRO do not have MCLs, and were not addressed by the ROD, AROD or Consent Decree, they have the potential to affect human health and, therefore, the ground water cleanup.

Contaminant concentrations in recovered ground water have declined with time since source material, soil, and sediment were removed in 1995. Seven ground water extraction system discharge samples were collected in 2005 and 2006. During this time, all analyte concentrations were below the corresponding MCLs. The vinyl chloride and 1,4-dioxane concentrations did, however, exceed other comparison criteria ie. HRLs/HBVs in some of the samples collected. While not detected in any of the three extraction system discharge samples collected in 2006, vinyl chloride was detected in three of the four samples and duplicate samples collected in 2005 at a concentration greater than its HRL (0.2 µg/L). The 1,4-dioxane concentration exceeded its HBV (30 µg/L) in six of the seven groundwater extraction system discharge samples/duplicates collected in 2005 and 2006.

The DRO concentration exceeds its HBV of 200 µg/L at on-site monitoring wells MW-3A and MPCA-4A on a regular basis. While DRO concentrations as high as 1,320 µg/L have been detected at MPCA-4A (April 2003), DRO concentrations have also been below the reporting limit during some sampling events (April 2005) at this location. The 2005 direct push investigation did not identify a more extensive DRO plume or any ongoing DRO source. With the exception of DRO at MW-3A, contaminant concentrations in ground water samples collected from monitoring wells located down-gradient of the French Drain have been below the corresponding MCLs, HRLs and HBVs for several years. At MW-3A, the DRO concentration has routinely been between 200 and 300 µg/L since November 2002.

The 1,4-dioxane concentration exceeds its HBV on a regular basis at on-site source area monitoring wells MPCA-4B, MPCA-5B and the extraction system discharge. The 2005 direct push investigation did not identify a more extensive 1,4-dioxane plume or any ongoing 1,4-dioxane source. With the exception of 1,4-dioxane at MPCA-4B and MPCA-5B, and vinyl chloride at on-site monitoring well MW-14A, the concentrations of all volatile organic compounds (VOCs) have been below their corresponding MCLs, HRLs and/or HBVs since at least April 2004. With respect to vinyl chloride at MW-14A, the vinyl chloride concentration has not exceeded its MCL (2.0 µg/L) since September 2001. The vinyl chloride concentration has, however, exceeded its HRL (0.2 µg/L) in approximately one-half the samples collected since that time.

Dissolved arsenic is the only parameter that exceeds its MCL in on-site source area monitoring wells. The dissolved arsenic concentration at MPCA-4B and MPCA-5B has ranged from less than the MCL to approximately 25 ug/l (2.5 times the MCL of 10.0 µg/L). The 2005 direct push investigation did not identify a more extensive dissolved arsenic plume or any ongoing arsenic source. With the exception of dissolved arsenic at MPCA-4B and MPCA-5B, the concentrations of all dissolved metals have been below their corresponding MCLs, HRLs and/or HBVs since at least April 2004.

Ground water cleanup goals for the site, as described in the ROD, AROD and Consent Decree, are for analytical concentrations to be less than the MCLs at the site perimeter. These cleanup goals have now been achieved and a trial shutdown of the groundwater extraction system began in March 2007 based on the recommendations of a Trial Groundwater Extraction System Shut-Down Report prepared by MPCA. VOCs, DRO, arsenic, and 1,4-dioxane concentrations will continue to be monitored as part of

performance monitoring associated with the trial shut-down. Performance monitoring associated with the trial shut-down will ensure that the cleanup goals continue to be met and also assess the potential for rebound and lateral migration of these compounds.

Site Inspection

A Site inspection for the third five-year review was conducted on July 25, 2007. Monitoring wells, ground water extraction equipment, the pump house for the ground water extraction system (structure, door, roof, electrical, fencing etc.) were all in good condition. Ground surface elevation has changed (i.e., increased) across much of the site, including the historic source area, as site development is proceeding in accordance with the MPCA approved Development Response Action Plan (DRAP). A DRAP is a plan for managing contaminated media during construction activities at properties under development. The elevations of some monitoring wells have been modified (i.e., increased) so the wells remain accessible as fill is imported to the site. These monitoring wells will need to be resurveyed. The drainage ditches which surround the site appeared to be functioning as intended. The culvert which drains water from the site to the south side of U.S. Highway 53 was open and free flowing. Two commercial, multi-unit, mini storage sheds have been constructed immediately north of the site. Refer to Attachment 4, Five-Year Review Site Inspection Checklist, for additional details concerning the inspection, including photographs.

Interviews

Mr. Karl Beaster, consultant for the property owners, was on-site for the site inspection to represent the property owners. Mr. Beaster and the property owners are in regular communication with the MPCA as part of the ongoing DRAP implementation. As such, formal interviews were not conducted.

VII. Technical Assessment

This section focuses on answering the following three key questions:

- Question A: Is the remedy functioning as intended by the decision documents?
- Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?
- Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Question A: Is the remedy functioning as intended by the decision documents?

YES

Source Materials, Soil and Sediment Phases

The remedy for source material, soil, and sediment phases is functioning as intended through a combination of remedial actions and institutional controls. The remedial actions for the source materials, soil, and sediments consisted of excavation, treatment on-site and off-site disposal. Excavations of visibly contaminated soils with organics and of lead contaminated soils were conducted in 1995 and 1996. The excavation actions, replacement fill, grading, and topsoil cover of the Site continue to meet cleanup levels, as described in the second five-year review. The 2002 five-year review identified potential effects from lead which exceeded the new Tier 2 SQT in sediments of the EPA drainage ditch south of the former Gopher Oil Building and downstream of it to the Highway 53 culvert (RI sampling 1985). This was subsequently eliminated because the sediments were removed.

With regard to whether the remedy is functioning as designed, some settled areas that possibly needed fill to final grade were identified in the 2002 five-year review. These have largely been addressed, or will be addressed as development under the approved DRAP continues. In the 2002 five-year review, it was also

reported that drainage modifications appear to have been made since close out of these RA phases in 1996, and there were other drainage issues that required resolution at the Site. Implementation of the approved DRAP is addressing these issues as well.

Ground Water Phase

The remedy for ground water is functioning as intended through a combination of remedial actions and institutional controls. The ground water remedy is functioning as intended by the decision documents. The system has been operating and functioning as designed, and was performing as expected during the five-year review period. The groundwater cleanup goal for the site, as described in the ROD and AROD, are for analytical concentrations to be less than the MCLs in the site perimeter. The cleanup goal have been achieved and a trial shutdown of the groundwater extraction system began in March 2007 based on the recommendations of a Trial Groundwater Extraction System Shut-Down Report prepared by Bay West, an MPCA contractor. Ground water monitoring will be performed in accordance with the plan provided in the Trial Ground Water Extraction System Shut-Down Report to assure the groundwater cleanup goal continues to be met.

Institutional Controls

At this time, initial IC evaluation activities have determined that some required ICs have been implemented for the on-site groundwater and soils, but other ICs have not been implemented. An IC Plan will be developed by MPCA/U.S. EPA within six months of this Five-Year Review. The two ICs which have been implemented are commercial/industrial zoning and the DRAP. Two additional ICs are planned for the Site which are an environmental covenant (MPCA has drafted a restrictive covenant, but the Minnesota Uniform Environmental Covenants Act recently passed and should be followed) and notice (record Consent Decree/access agreements).

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of remedy selection still valid?

YES

Changes in Standards and To Be Considereds (TBCs)

Some standards identified in the ROD have been revised; there are newly promulgated standards; and To Be Considered (TBC) criteria used in selecting cleanup requirements for the Site have changed; some of these may call into question the protectiveness of the remedy.

For Source Materials: The source materials were completely excavated and there are no issues. This phase is closed.

For Soils: Only chemicals that were detected in soil during the current five-year review period were evaluated. Soil sampling during this time was limited to a direct push investigation performed in June 2005 to assess the potential for an ongoing arsenic, DRO and 1,4-dioxane source(s) in the historic source area. Only DRO and arsenic were detected in soil samples collected during the investigation. An extensive review of all analytes referenced in the ROD and AROD was presented in the second five-year review. The conclusion at that time was that the remedy was still protective. DRAP implementation is resulting in several feet of clean fill from off-site sources being added to much of the site. This additional soil increases the protectiveness and the potential for exposure to native soil is reduced. Given the amount of time that has past since the soil remedy was implemented and the additional development and institutional controls at the site, a full review of all the historical contamination was not considered warranted.

Previous and new standards for DRO and arsenic in soil are presented in Table 5. From a historical perspective, arsenic has never been identified as a contaminant in soil, so there was no limit cited in the

AROD or the second-five-year review. Soil standards have not been established for DRO. 1,4-dioxane was not detected in soil. However, the reporting limits of <27 to <110 mg/kg were approximately three orders of magnitude greater than the Tier 1 Soil Leaching Value (SLV) of 0.031 mg/kg. This indicates that residual 1,4-dioxane contamination in historic source area soil may be present at the site at sufficient concentrations to pose a risk to ground water although it was not detected during the investigation. This possible scenario is consistent with the observed concentrations of 1,4-dioxane in ground water. However, at this time analytical techniques do not exist to detect 1,4-dioxane at the MPCA Tier 1 SRV and therefore, no additional soil sampling is planned.

Table 5: Changes in Chemical-Specific Standards - Soil

Contaminant	Max Conc. (11/02- 10/06) in mg/kg	Old Standard	Citation/Year	New Standard	Citation/Year
DRO	107	NE	NE	NC	NC
Arsenic	15	NR	NR	20 mg/kg	MPCA 2005

Notes:

NC – No change since last five-year review

NE – standard not established

NR – not reported in last five-year review so old standard, if shown, is from AROD

For Sediments: New TBCs that apply to sediments were presented in the second five-year review. However, the sediments have been removed so the potential risk has been eliminated.

For Ground Water: Only chemicals that were detected in ground water, either in monitoring wells, push probes, or the system discharge, during the current five-year review period were evaluated. Given the amount of time that has passed since the ground water remedy was implemented and the orders-of magnitude decrease in ground water contamination over that time, a full review of all compounds listed in the historical record was not considered warranted.

The original groundwater cleanup goals were based on meeting MCLs at the site perimeter. Pursuant to the Safe Drinking Water Act (SDWA), MCLs are based on health (using the federal risk database known as IRIS), cost, technological feasibility, detection level, ability for consistent lab results, and other factors. The Minnesota Department of Health (MDH) uses IRIS numbers in addition to a number of other sources and professional judgment to develop Health Risk Limits (HRLs) (promulgated in state rules) and Health Based Values (HBVs) (new advisory numbers likely to be promulgated). The HRLs and HBVs are strictly health-based and use a 10^{-5} risk level as the basis for acceptable risk and are considered to be potential TBCs for the site. The MPCA uses the HRLs and HBVs to evaluate risk, then incorporates feasibility, cost, etc. into its cleanup decisions. Previous and new standards for chemicals detected in ground water during the current five-year review period are presented in Table 6.

Table 6: Changes in Chemical-Specific Standards – Ground Water

Contaminant	Max Conc. (11/02- 10/06) in ug/L	Old Standard	Citation/Year	New Standard	Citation/Year
Cis- 1,2-Dichloroethene	7.4	70 ug/L	MDH HRL 1994	NC	NC
1,4-Dioxane	960	30 ug/L	MDH HBV	NC	NC
2-Methylnaphthalene	0.03	NE	NE	NC	NC

4-Methyl-2-pentanone (MIBK)	49	NR (NE)	NR (NE)	300 ug/L	MN Rules
Acetone	170	700 ug/kg	MN Rules	NC	NC
Arsenic	30.8	50 ug/L	SDWA 1994	10 ug/L	SDWA 2001 (effective 2006)
Benzene	3.5	10 ug/L	SDWA	5 ug/L	SDWA, and MN Chapter 147, 2007
Bis(2-Chloroethyl)ether	5	NR	NR	3 ug/L	MN Rules
bis(2-Ethylhexyl)phthalate (DEHP)	12	6 ug/L/20 ug/L	SDWA 1998/MDH HBV	6 ug/L	SDWA 1998/ MN Rules 2007
Bromomethane	21	NR	NR	10 ug/L	MN Rules
Chloromethane	8.1	NR	NR	3 ug/L	MDH LHA
Dichlorodifluoromethane	22.4	NR	NR	1000 ug/L	MN Rules
DRO + GRO	5520	200 ug/L	MDH HBV	NC	NC
Ethyl ether	9.5	NR	NR	1000 ug/L	MN Rules
Iron	5930	NR	NR	300 ug/L	SDWA (secondary standard)
Lead	0.99	15 ug/L Total at the tap (TT)	SDWA 1991	NC	NC
Methyl Ethyl Ketone (2-Butanone)	62	4000 ug/L	MN Rules 1993	NC	NC
Naphthalene	0.022	400 ug/L	MN Rules 1993	300 ug/L	MN Rules
Trichloroethene	5	5 ug/L	SDWA 1987 and MDH HBV	5 ug/L	SDWA 1987 and MN Chapter 147, 2007
Tetrahydrofuran	2.1	NR	NR	100 ug/L	MDH HBV
Vanadium	7.53	50 ug/L	MN Rules 1994	NC	NC
Vinyl Chloride	3.2	2.0 ug/L/0.2 ug/L	SDWA 1987/MN Rules 1994	NC	NC
Zinc, dissolved	6170	2000 ug/L	MN Rules 1994	NC	NC

Notes:

NC – no change since last five-year review

NE – standard not established

NR – not reported in last five-year review so old standard, if shown, is from AROD

SDWA – Federal MCL established in Safe Drinking Water Act

MN Rules - MDH Health Risk Limit, MN Rules 4717.7100-4717.7800 1993/1994

MN Chapter 147 - Effective July 1, 2007 the HRL value promulgated in 1993/4 has been revised to the current MCL value as required by MN Session Laws 2007, Chapter 147, Article 17, section 2

The analytes that exceeded the ground water standards in one or more samples include dissolved arsenic, bis(2-chloroethyl)ether, bis(2-ethylhexylphthalate), bromomethane, chloromethane, dichlorodifluoromethane, GRO and DRO as TPH, trichloroethene, vinyl chloride, and dissolved zinc. In addition, iron in the discharge exceeded the secondary drinking water standard. Several of the analytes were not previously detected at the site (1,4 dioxane) and were not tabulated in the previous five-year review or the

AROD. However, most of these analytes were typically detected in only a few samples, at concentrations below their respective standards. Recent monitoring, as summarized in the annual reports, has eliminated all of these chemicals from further concern, except for VOCs (specifically vinyl chloride), DRO, arsenic, and 1,4-dioxane.

The DRO (HBV), 1,4-dioxane (HBV) and dissolved arsenic (MCL) concentrations routinely exceed standards in on-site source area monitoring wells. Additionally, 1,4-dioxane is routinely detected at a concentration greater than its HBV in the extraction system discharge. The maximum concentration of arsenic in an on-site groundwater monitoring well (30.2 ug/l) exceeds the new MCL of 10 ug/l. The previous MCL of 50 ug/l represents an approximate 10^{-3} (1 in 1000) cancer risk which is outside U.S. EPA's acceptable cancer risk range of 10^{-4} - 10^{-6} . Vinyl chloride is detected on an intermittent basis at concentrations greater than its HRL, but less than its MCL, in the source area. Because the exceedance of the HRLs/HBVs for DRO and 1,4-dioxane and vinyl chloride and the new MCL for arsenic are limited to some of the on-site monitoring wells and the extraction system discharge, no action will be taken to adopt the new ARARs/TBCs for these contaminants, since the remedy is considered to be protective. Monitoring for these parameters will be performed as part of the trial ground water extraction system shut-down. Should future groundwater monitoring determine that these contaminants are moving off-site, further evaluation of the ARARs/TBCs will be performed.

For Surface Water: In 2005, the MPCA performed an internal evaluation of surface water receptors and applicable ground water criteria to protect these receptors. The purpose of the evaluation was to assess the potential for contaminated ground water from the site having a negative impact on surface waters, especially with respect to the newer contaminants found in the groundwater (e.g., 1,4-dioxane). Monitoring wells MW-3A, MW-3B, MPCA-3S, MW-9A, MW-9B, MW-10A, MW-10B, MW-17B, MW-17E and P-17, and manholes MH-2, MH-3, and MH-4 were identified as surface water compliance points. Details of the evaluation were presented in the 2005 Annual Monitoring Report.

MPCA Superfund staff reviewed the recommendations of Surface Water staff. Based on their more detailed knowledge concerning screen depths and site specific hydrogeology, Superfund staff removed monitoring wells MW-17B, MW-17E and MW-P-17 as potential surface water compliance points.

Class 2B water quality standards/criteria/guideline values for analytes routinely detected over the past three years are:

- Arsenic 53 µg/L
- Lead* 4.1 µg/L
- Zinc* 89 µg/L
- Vinyl Chloride 9.2 µg/L
- 1,4-dioxane 1,294 µg/L
- DRO 200 µg/L

*The lead and zinc numbers are based on a receiving water hardness of 70 mg/L as CaCO₃.

Of these analytes, only DRO and total lead have been detected in the compliance wells at concentrations exceeding the Class 2B criteria. However, it is considered unlikely the lead concentrations detected at MPCA-3S are related to historic facility operations. The potential for DRO to adversely impact surface water will be assessed as part of the performance monitoring plan associated with the trial ground water extraction system shut-down.

Changes in Exposure Pathways, Toxicity and Other Contaminant Characteristics

There have been no changes in land use, which remains zoned as industrial/restricted commercial and is presently used for one warehouse and otherwise as open land.

There are no changes in human health or ecological routes of exposure and no receptors have been newly identified.

Changes in Toxicity and Other Contaminant Characteristics

While new toxicity values have been established for several contaminants, none of the changes affect the protectiveness of the remedy.

There have been no changes in contaminant characteristics that could affect the protectiveness of the remedy.

Changes in Risk Assessment Methods

For ground water and soil, there are no changes in standardized risk assessment methodologies that could affect the protectiveness of the remedies.

Expected Progress Towards Meeting RAOs

For ground water, progress toward meeting RAOs is much better than expected. The original projected time for ground water cleanup was up to 25 to 50 years. In the second five-year review, the ground water was projected to meet MCLs within the next 4 to 8 years, which would be 2006 to 2010, and this goal has largely been achieved. As a result, a trial ground water extraction system shut-down and associated ground water monitoring program were implemented in March 2007 and is scheduled to be completed in June 2009.

There are no changes in action-specific or location-specific requirements.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

NO

No newly identified ecological risks have been found. There are no impacts from natural disasters. No other information is known that could affect the protectiveness of the remedy.

Technical Assessment Summary

The three phases were evaluated for changes in chemical-specific, action-specific and location-specific Applicable or Relevant and Appropriate Requirements (ARARs) and other Site physical characteristics. All known applicable files were reviewed. A Site inspection, which included the MPCA's O&M contractor and the site owner's development consultant, was conducted. At the Site inspection, changes from the as-built Site close-out reports were compared to the Site's existing condition.

To answer Question A for the Soils and Sediments Phase, MPCA staff evaluated the cleanup and its objectives. The soils remedy was essentially completed and documented by the time of the second five-year review. In addition, clean fill has been brought onto the site and raised the elevations, further restricting access to the subsurface soils, and draft institutional controls are being complied with. An environmental covenant needs to be finalized and filed with the St. Louis County Recorder's Office by the current property owner. Therefore, this five-year review focused on evaluating new soil data collected as part of the direct push investigation, aimed at investigating 1,4-dioxane, DRO, and arsenic routinely detected in ground water. The 1,4-dioxane, arsenic and DRO concentrations detected in soils were determined not to be elevated enough to have the potential of being a continuing source of contamination to ground water.

To answer Question A for Ground Water, MPCA staff evaluated all current ground water monitoring well data, the rates of ground water cleanup, and documentation that the discharge water met all WLSSD

discharge requirements. Ground water was found to be remediated much faster than expected and met the requirements for a trial system shutdown within the period projected in the last five-year review.

To Answer Question B for soils and ground water, MPCA staff assembled the pertinent new standards and policies and summarized changed or new standards in Tables 5 and 6. The contaminants were limited to those detected during this five-year review period. This was done because the soil remedy is complete and the groundwater remedy is in the long-term operation stage and therefore, many of the contaminants and associated concentrations specified in the ROD and AROD are no longer representative of current site conditions. Based on results from a direct push investigation of soils completed in 2005, no ongoing source of DRO, 1,4-dioxane or arsenic impacts to ground water was identified in the historic source area. The importing of fill on-site, associated with the DRAP implementation, is resulting in improved surface water drainage from the historic source area and a decrease in the potential for worker contact with native soil in this area. Because the exceedance of the HRLs/HBVs in groundwater for DRO, 1,4-dioxane and vinyl chloride and also the new MCL for arsenic are limited to some of the on-site monitoring wells and the extraction system discharge, no action will be taken to adopt the new ARARs/TBCs for these contaminants, since the remedy is considered to be protective. However, should future groundwater monitoring determine that these contaminants are moving off-site, further evaluation of the ARARs/TBCs will be performed.

For the source materials Phase, excavation was complete and the Phase is closed. There are no known issues with regard to this Phase.

For sediments Phase, the potential risk was eliminated by removal of the sediments.

The MPCA also performed an internal evaluation of surface water receptors and determined DRO has the potential to migrate from ground water to surface water at a concentration that exceeds a potential TBC. This concern will be monitored as a component of performance monitoring associated with the trial ground water extraction system shut-down, with the routine determination of the DRO concentration in compliance wells for the surface water migration pathway.

With regard to Question C, there are no newly identified ecological risks. There are no impacts from natural disasters, or any other information than that already presented, that may affect the protectiveness of the remedy.

VIII. Issues

At this time, initial IC evaluation activities have determined that some required ICs have been implemented for the on-site groundwater and soils but other ICs have not been implemented. An IC Plan will be developed by MPCA/U.S. EPA within six months of this Five-Year Review. The two ICs which have been implemented are commercial/industrial zoning and the DRAP. Two additional ICs are planned for the Site which are an environmental covenant (MPCA has drafted a restrictive covenant, but the Minnesota Uniform Environmental Covenants Act recently passed and should be followed) and a notice (record Consent Decree/access agreements).

The concentrations of all groundwater contaminants have been below their corresponding MCLs in the extraction system discharge and at the site perimeter for over two years. The ROD, AROD and Consent Decree allow the ground water extraction system to be shut-down once MCLs have been achieved at the site perimeter. Therefore, the trial system shutdown was initiated in March 2007. Trial system shutdown monitoring is in progress to verify that no MCL or HRL/HBV exceedances are observed at the site perimeter.

Dissolved arsenic exceeds the new MCL in source area monitoring wells. DRO concentrations exceed State of Minnesota HBV and also Class 2B surface water criteria in source area monitoring wells. 1,4-dioxane concentrations also exceed its HBV on a regular basis in source area monitoring wells and the

extraction system discharge. Vinyl chloride intermittently exceeds the HRL but not the MCL in an on-site monitoring well. It should be noted that none of these contaminants exceed HRLs/HBVs or MCLs beyond the site perimeter compliance point and therefore, the groundwater monitoring conducted as part of the trial shut-down is expected to verify that groundwater cleanup goals have been met. However, should future groundwater monitoring determine that these contaminants are moving off-site, further evaluation of the ARARs/TBCs will be performed.

The MPCA performed an internal evaluation of surface water receptors and determined DRO has the potential to migrate from ground water to surface water at a concentration that exceeds the applicable surface water quality standard. This concern will be monitored as a component of performance monitoring associated with the trial ground water extraction system shut-down, with the routine determination of the DRO concentration in compliance wells for the surface water migration pathway.

Table 7: Issues

Issues	Affects Current Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
1. Environmental covenant and Consent Decree are not filed at the Recorder's office. Also, the ICs have not been fully evaluated and some of the ICs have not been implemented. A review of the institutional controls is needed to assure that the remedy is functioning as intended with regard to the ICs and to ensure effective procedures are in-place for long-term stewardship at the Site. Long-term stewardship must be assured which includes implementing, maintaining and monitoring effective ICs.	N	Y
2. Based on a review of the groundwater extraction system performance which indicates that cleanup goals have been achieved, the recommendation was made to discontinue system operation, and a trial shut down was initiated. A few ground water standard exceedances are still periodically observed in on-site monitoring wells.	N	Y
3. There are new potential ARARs and TBCs for certain groundwater contaminants found in on-site monitoring wells (DRO, 1,4-dioxane, vinyl chloride and arsenic).	N	Y
4. A recent evaluation by MPCA has determined that DRO has the potential to migrate from groundwater to surface water at concentrations of concern.	N	Y

IX. Recommendations and Follow-up Actions

Recommendations and follow-up-actions to site issues are summarized below in Table 8.

Table 8: Recommendations and Follow-up Actions

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
<p>1. The required environmental covenant and Consent Decree are not filed at the Recorder's office. Also, the ICs have not been fully evaluated and some of the ICs have not been implemented.</p> <p>A review of the institutional controls is needed to assure that the remedy is functioning as intended with regard to the ICs and to ensure effective procedures are in-place for long-term stewardship at the Site. Long-term stewardship must be assured which includes implementing, maintaining and monitoring effective ICs.</p>	<p>An Institutional Control Plan will be prepared documenting necessary IC evaluation activities and necessary corrective measures.</p> <p>* See Below</p>	MPCA/EPA	EPA	March 2008	No	Yes

Issue	Recommendations and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)	
					Current	Future
2. Based on a review of the groundwater extraction system performance, the recommendation was made to discontinue system operation and a trial shut down period was initiated. A few groundwater standard exceedances are periodically observed in on-site monitoring wells.	Continue performance monitoring during trial shut-down and verify that ARARs and TBCs continue to be met at the compliance point which is the site boundary.	MPCA	EPA	June 2009	No	Yes
3. There are new potential ARARs and TBCs for certain groundwater contaminants found in on-site monitoring wells (DRO, 1,4-dioxane, vinyl chloride, and arsenic).	Groundwater monitoring at the site perimeter will continue and if exceedances of potential ARARs and TBCs are seen outside the site boundary, the need for a new decision document (e.g., ESD or ROD amendment) will be evaluated.	EPA	EPA	June 2009	No	No
4. DRO has the potential to migrate from groundwater to surface water at concentrations of concern.	DRO will be monitored as a component of groundwater performance monitoring for the trial shut-down.	MPCA	EPA	June 2009	No	Yes

* An IC Plan will be developed by MPCA/U.S. EPA within six months of this Five Year Review to plan IC evaluation activities. Those activities shall include evaluating the effectiveness of existing ICs which have been implemented, evaluating whether additional ICs are needed, mapping ICs, and evaluating the property title to determine whether some interest, such as a mortgage or utility easement, might defeat the efficacy of the institutional controls. The IC Plan should also plan for long-term stewardship including a mechanism for regular inspections (at least annual) of the effectiveness of the ICs in place. In the event that the trial groundwater extraction system shutdown is resulting on contaminants migrating off-site, the IC Plan should include an evaluation of ICs which would prevent use of the contaminated groundwater which has migrated off-site.

X. Protectiveness Statement(s)

Protectiveness Statement

The remedy for source materials, soil and sediments is expected to be or is protective of human health and the environment, and in the interim, exposure pathways that could result in unacceptable risks are being controlled. The remedy for groundwater currently protects human health and the environment because the remedial action objectives are being met at the site boundary and several ICs are in place. However, in order for the remedy to be protective in the long-term, the following actions need to be taken. Trial shutdown ground water monitoring will be performed for several more years to verify that ground water cleanup goals have been achieved and protectiveness is maintained. Additionally, groundwater will be monitored to determine if surface water is being impacted at the site. Groundwater will also be monitored for contaminants which have potential new Applicable or Relevant and Appropriate Requirements (ARARs) and/or To Be Considereds (TBCs), and if exceedances of potential ARARs and TBCs are seen outside the site perimeter, the need for a new decision document (e.g., [ESD] or ROD amendment) will be evaluated.

Finally, institutional controls (ICs) for the Site property and groundwater are required to ensure no inappropriate use of the Site or groundwater occur. Long-term protectiveness requires compliance with effective ICs. To ensure the remedy continues to function as designed, an IC plan will be prepared along with necessary corrective measures, so that long-term stewardship is ensured.

XI. Next Review

The next five-year review for the Arrowhead Refinery Site is required five years from the signature date of this review.

Attachment 1

Site Maps

Figure 1 – Site Location Map

Figure 2 – Consent Decree Map

**Figure 3 – May 1997 Water Table
Contour Map**

Site Location

Superfund
U.S. Environmental Protection Agency



Arrowhead Refinery St. Louis County, MN

MND980823975



State



County



Site

Figure 1

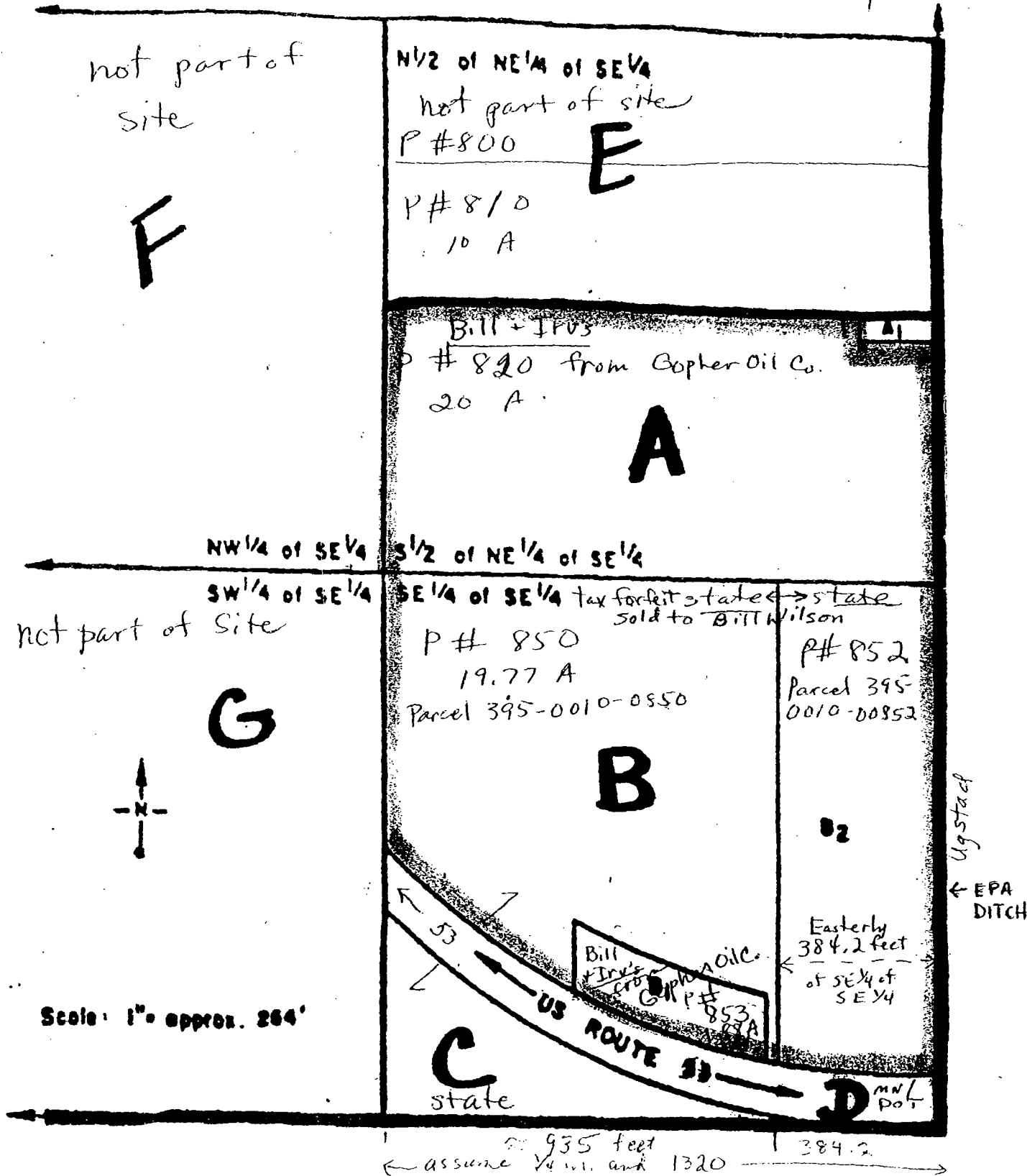
Produced by Sarah Backhouse
U.S. EPA Region 5 on 5/2/07
Image Date: 2003



Appendix C

450 N R15W S4

ATTACHMENT 1



Arrowhead Refining Site

Includes Parcels A, B, B1 and B2; and excludes Parcels A1, C, D, E, F, and G.

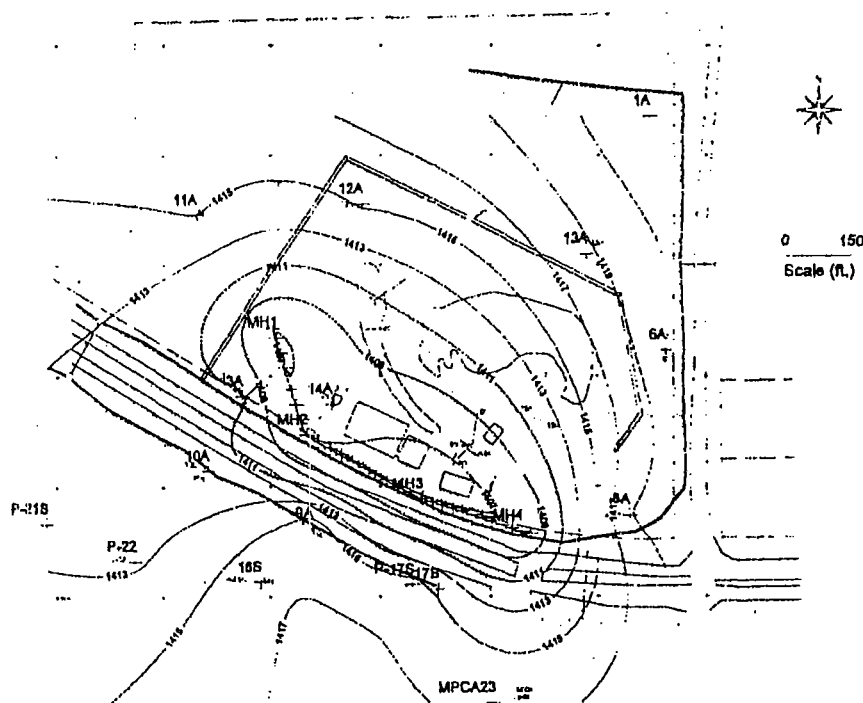
Figure 2

The base site map is from the ROD.
Type written on base map is from Consent Decree.

reportedly observed in the Carlson well after the recovery system was started (Mr. Carlson, personal communication).

The 1405-ft. ground water elevation in the recovery trenches was generally maintained from the time of system implementation until the Spring of 1997, at which time the elevation in the recovery trenches was raised. This adjustment was made because the higher discharge rate that was used during source material remediation activity (in part to facilitate dewatering for excavation operations) was no longer necessary. As a result of this decrease in discharge, the water level in the recovery trenches has been raised from the previous level of 1405-ft. to the 1407-ft. level. This change required a number of adjustments in order to stabilize, but was completed in May, 1997. A water table contour map for the site at that time is shown below.

Arrowhead Ground Water Contour Map (May 1, 1997)



This ground water contour map indicates a more than adequate zone of capture across the site is being maintained. Ground water flow directions are also consistent with those previously observed.

Figure 3 – May 1997 Water Table Contour Map

Attachment 2

Community Notification

Announcement of a Five-Year Review for the Arrowhead Refinery Superfund Site

The Minnesota Pollution Control Agency (MPCA) is beginning a third Five-year Review of the Arrowhead Refinery Superfund site cleanup, Hermantown, Minnesota. Superfund law requires reviews of sites where the cleanup is either in progress or completed but hazardous waste remains managed on-site. These Five-year Reviews ensure the cleanup continues to protect human health and the environment. The U.S. Environmental Protection Agency (EPA) participated in the site cleanup and is participating in the Five-year Reviews.

The site was formerly a waste oil recycling facility which accepted wastes and operated from 1945 to 1977.

In 1986, EPA issued a Record of Decision and in 1994, an Amended Record of Decision, which resulted in the cleanup of approximately 4,600 tons of source material, and contaminated soil, sediment, and ground water. In 1993, EPA initiated the cleanup of the site's ground water with the installation of a ground water extraction system. Cleanup of the source material, soil, and sediment was completed in 1995 and 1996. In 1996, MPCA took over long-term operation and maintenance of the ground water system.

The purpose of the Five-year Review is to ensure the cleanup continues to protect human health and the environment, and to evaluate whether the cleanup goals in the site Record of Decision, as amended, remain protective of human health and the environment. The review will be completed by September 30, 2007.

In the second Five-year Review in 2002, MPCA found the site protective of human health and the environment. The MPCA further found that hazardous substances, pollutants, or contaminants remain at the site and would not allow for unlimited use or unrestricted use at the existing level of site cleanup.

No formal meeting or public comment period is required for this review. However, the MPCA invites public opinion. Comments should be submitted no later than September 21, 2007 and be directed to the site Public Information Officer or the site Project Leader listed below. The community can contribute by providing information that may have been observed at the site or ways that the cleanup has helped the area. Local citizens are encouraged to bring information and any concerns related to the site or requests for more information to the attention of:

Anne Perry-Moore, Public Information Officer	or	Jane Mosel, site Project Leader
Minnesota Pollution Control Agency		Minnesota Pollution Control Agency
525 S. Lake Ave., Suite 400		525 S. Lake Ave., Suite 400
Duluth, MN 55802		Duluth, MN 55802
(218) 723-2356		(218) 529-6250
Toll-free 800-657-3864		Toll-free 800-657-3864

The site's EPA fact sheet is located at www.epa.gov/region5/superfund/npl/minnesota/index.html. Site documents are available for review at the Duluth MPCA office, 525 S. Lake Ave., Suite 400, and the Duluth Public Library, 520 West Superior Street, both located in Duluth, Minnesota. These documents will provide more detail on the selected remedy and subsequent cleanup.

Attachment 3

List of Documents Reviewed

1. The Arrowhead Refining Company Oil Spill On-Scene Coordinator's Report, U.S. EPA Region V, February 9, 1981.
2. Remedial Investigation Report, Arrowhead Refinery Site, Hermantown, Minnesota, Volumes 1 and 2, CH2M Hill, August 25, 1986.
3. Transcript of Public Meeting, Arrowhead Superfund Site, Hermantown High School, U.S. EPA Region V, September 15, 1986.
4. Record of Decision – Remedial Alternative Selection, Arrowhead Refinery Site, U.S. Region V, September 30, 1986.
5. Unilateral Order for water main and groundwater extraction and treatment system, U.S. EPA, March 1990.
6. Fieldwork Design Investigation, Arrowhead Refinery Site, Hermantown, Minnesota, Volumes 1-3, CH2M Hill, April 30, 1990.
7. Residential Well Abandonment Report, Barr Engineering Company, December 17, 1990.
8. Remedial Action Implementation Report, Water Main Extension and Well Abandonment, Arrowhead Refinery Site, Barr Engineering Company, December 1991.
9. Public Health Assessment for Arrowhead Refinery Company, Hermantown, St. Louis County, Minnesota, ATSDR, September 23, 1993.
10. Amendment to the Record of Decision Declaration, Arrowhead Refinery Site, U.S. EPA, Region V, February 9, 1994.
11. Groundwater Remediation System Long-Term Remedial Action Operations and Maintenance Work Plan, Arrowhead Refinery, PRC Environmental Management, Inc., July 24, 1995.
12. Groundwater Extraction System, Operations and Maintenance Manual, Arrowhead Refiner Site, Hermantown, Minnesota, Barr Engineering Company, July 1995.
13. Consent Decree, 1995.
14. Phase I Residuals, Phase II Contaminated Soils and Sediments, Remedial Action Closure Report, Arrowhead Refinery Site, Hermantown, Minnesota, CH2M Hill, November 1996.
15. Preliminary Close Out Report, U.S. EPA, December 19, 1996.
16. Completion of the Remedial Action Report, Completion of the Work Report for the Arrowhead Refinery Site, 7-7, Inc., and Service Environmental Engineering, December 23, 1996.
17. Site Review and Update, MDH, November 21, 1996.
18. Remedial Action Completion Report, Source Materials, MASC, May 21 1997.
19. Five-Year Review Report, Arrowhead Refining Company Superfund Site, Hermantown, Minnesota, MPCA, September 20, 1997.

20. Second Five-Year Review Report, Arrowhead Refinery Site, Hermantown, St. Louis County, Minnesota MPCA, September 30, 2002.
21. Annual Reports, 1996-1997, 1997-1998, April 1998 to February 2000, February 2000 through March 2001, 2001, 2002, 2003, 2004, 2005, 2006.
22. Ground Water Remediation System Performance Evaluation Report, Arrowhead Refinery, Hermantown, Minnesota, Bay West, Inc., October 2004.
23. Updated Receptor Survey, Arrowhead Refinery Superfund Site, Hermantown, Minnesota, Bay West, Inc., January 11, 2005.
24. Letter Report to U.S. EPA regarding Arrowhead Refinery Superfund Site, MPCA, January 27, 2005.
25. Arsenic, Zinc and 4-Methylphenol Sampling Results, Arrowhead Refinery Superfund Site, Hermantown, Minnesota, Bay West, Inc., May 25, 2005.
26. Development Response Action Plan, Former Arrowhead Refinery Site, State Hwy. 53 and Ugstad Road, Hermantown, Minnesota, AET, Inc., July 12, 2006.
27. Conceptual Approval Letter for the Development Response Action Plan for the Former Arrowhead Refinery Site, MPCA, September 27, 2006.
28. Trial Ground Water Extraction System Shut Down Report, Former Arrowhead Refinery, Hermantown, Minnesota, Bay West, Inc., April 2007.

(Working document for site inspection. Information may be completed by hand and attached to the Five-Year Review report as supporting documentation of site status. "N/A" refers to "not applicable.")

Inspection Team

Jane Mosel, Project Manager, MPC A
Mike Bares, Hydrogeologist, MPC A
Paul Wulz, Project Manager (Bay West, Inc.)
O & M contractor

3. **Local regulatory authorities and response agencies (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.)** Fill in all that apply.

Agency _____
Contact _____

Name	Title	Date	Phone no.
Problems; suggestions; Report attached			

Agency _____					
Contact _____					
Name _____		Title _____	Date _____	Phone no. _____	
Problems; suggestions; Report attached _____					

Agency _____		_____		_____		_____	
Contact _____		_____		_____		_____	
Name _____		Title _____		Date _____		Phone no. _____	
Problems; suggestions; Report attached _____		_____		_____		_____	

Agency _____
 Contact _____

Name	Title	Date	Phone no.
Problems; suggestions; Report attached			

4. **Other interviews (optional)** Report attached.

Karl Beaster, American Engineering Testing, Inc., Consultant for the current property owner, was on-site during the Site Inspection to provide feedback and answer questions.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)				
1.	O&M Documents O&M manual As-built drawings Maintenance logs Remarks _____	<input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date	N/A N/A N/A
2.	Site-Specific Health and Safety Plan Contingency plan/emergency response plan Remarks _____	<input checked="" type="checkbox"/> Readily available Readily available	<input checked="" type="checkbox"/> Up to date Up to date	N/A <input checked="" type="checkbox"/> N/A
3.	O&M and OSHA Training Records Remarks _____	<input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date	N/A
4.	Permits and Service Agreements Air discharge permit Effluent discharge Waste disposal, POTW Other permits Remarks _____	Readily available <input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Readily available	Up to date <input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> Up to date	<input checked="" type="checkbox"/> N/A N/A N/A N/A
Other: <u>Property owner has permits with MDNR and USACE for filling wetlands</u>				
5.	Gas Generation Records Remarks _____	Readily available	Up to date	<input checked="" type="checkbox"/> N/A
6.	Settlement Monument Records Remarks _____	Readily available	Up to date	<input checked="" type="checkbox"/> N/A
7.	Groundwater Monitoring Records Remarks _____	<input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date	N/A
8.	Leachate Extraction Records Remarks _____	Readily available	Up to date	<input checked="" type="checkbox"/> N/A
9.	Discharge Compliance Records Air Water (effluent) Remarks _____	Readily available <input checked="" type="checkbox"/> Readily available	Up to date <input checked="" type="checkbox"/> Up to date	N/A N/A
10.	<u>Weekly</u> Daily Access/Security Logs Remarks _____	<input checked="" type="checkbox"/> Readily available	<input checked="" type="checkbox"/> Up to date	N/A

IV. O&M COSTS																																																					
1.	O&M Organization State in-house PRP in-house Federal Facility in-house Other _____	<input checked="" type="checkbox"/> Contractor for State Contractor for PRP Contractor for Federal Facility																																																			
2.	O&M Cost Records <i>See Five-Year Review Report</i> <input checked="" type="checkbox"/> Readily available <input checked="" type="checkbox"/> Up to date <input checked="" type="checkbox"/> Funding mechanism/agreement in place Original O&M cost estimate _____ Breakdown attached <div style="text-align: center;">Total annual cost by year for review period if available</div> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 15%;">From _____</td> <td style="width: 15%;">To _____</td> <td style="width: 15%;"></td> <td style="width: 15%;"></td> <td style="width: 40%;">Breakdown attached</td> </tr> <tr> <td style="text-align: center;">Date</td> <td style="text-align: center;">Date</td> <td style="text-align: center;">Total cost</td> <td></td> <td></td> </tr> <tr> <td>From _____</td> <td>To _____</td> <td></td> <td></td> <td>Breakdown attached</td> </tr> <tr> <td style="text-align: center;">Date</td> <td style="text-align: center;">Date</td> <td style="text-align: center;">Total cost</td> <td></td> <td></td> </tr> <tr> <td>From _____</td> <td>To _____</td> <td></td> <td></td> <td>Breakdown attached</td> </tr> <tr> <td style="text-align: center;">Date</td> <td style="text-align: center;">Date</td> <td style="text-align: center;">Total cost</td> <td></td> <td></td> </tr> <tr> <td>From _____</td> <td>To _____</td> <td></td> <td></td> <td>Breakdown attached</td> </tr> <tr> <td style="text-align: center;">Date</td> <td style="text-align: center;">Date</td> <td style="text-align: center;">Total cost</td> <td></td> <td></td> </tr> <tr> <td>From _____</td> <td>To _____</td> <td></td> <td></td> <td>Breakdown attached</td> </tr> <tr> <td style="text-align: center;">Date</td> <td style="text-align: center;">Date</td> <td style="text-align: center;">Total cost</td> <td></td> <td></td> </tr> </table>			From _____	To _____			Breakdown attached	Date	Date	Total cost			From _____	To _____			Breakdown attached	Date	Date	Total cost			From _____	To _____			Breakdown attached	Date	Date	Total cost			From _____	To _____			Breakdown attached	Date	Date	Total cost			From _____	To _____			Breakdown attached	Date	Date	Total cost		
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3.	Unanticipated or Unusually High O&M Costs During Review Period Describe costs and reasons: <i>Unanticipated or unusually high O&M costs did not occur during the review period</i> _____ _____ _____ _____																																																				
V. ACCESS AND INSTITUTIONAL CONTROLS <input checked="" type="checkbox"/> Applicable N/A																																																					
A. Fencing																																																					
1.	Fencing damaged <input checked="" type="checkbox"/> Location shown on site map <input checked="" type="checkbox"/> Gates secured N/A Remarks <i>Fencing around control house for ground water extraction system. Fence is in good condition.</i>																																																				
B. Other Access Restrictions																																																					
1.	Signs and other security measures Location shown on site map <input checked="" type="checkbox"/> N/A Remarks _____																																																				

C. Institutional Controls (ICs)			
1.	Implementation and enforcement		
	Site conditions imply ICs not properly implemented	Yes <input checked="" type="checkbox"/> No N/A	
	Site conditions imply ICs not being fully enforced	Yes <input checked="" type="checkbox"/> No N/A	
	Type of monitoring (e.g., self-reporting, drive by) <u>Inspection During O & M</u>		
	Frequency <u>Weekly</u>		
	Responsible party/agency <u>MPCA Consultant - Bay West, Inc</u>		
	Contact <u>Paul Walz</u>	Title <u>Project manager</u>	Phone no. <u>(651) 291-3491</u>
	Reporting is up-to-date	<input checked="" type="checkbox"/> Yes No N/A	
	Reports are verified by the lead agency	<input checked="" type="checkbox"/> Yes No N/A	
	Specific requirements in deed or decision documents have been met	Yes <input checked="" type="checkbox"/> No N/A	
	Violations have been reported	Yes <input checked="" type="checkbox"/> No N/A	
	Other problems or suggestions: Report attached		
	<u>Two ICs (Zoning and DRAP) have been implemented</u>		
	<u>Two ICs (Restrictive Covenant and recording Consent Decree/</u>		
	<u>access agreements) remain to be completed.</u>		
2.	Adequacy <input checked="" type="checkbox"/> ICs are adequate ICs are inadequate N/A		
	Remarks <u>While ICs are being followed, complete adequacy</u>		
	<u>will not be achieved until restrictive covenant is in</u>		
	<u>place and Consent Decree access agreements are recorded.</u>		
D. General			
1.	Vandalism/trespassing	Location shown on site map	No vandalism evident
	Remarks _____		
2.	Land use changes on site	N/A	
	Remarks <u>Site development is occurring in accordance with the</u>		
	<u>approved DRAP</u>		
3.	Land use changes off site	N/A	
	Remarks <u>Two commercial, multi-unit, mini storage sheds have been</u>		
	<u>constructed north of the site.</u>		
VI. GENERAL SITE CONDITIONS			
A. Roads	Applicable	<input checked="" type="checkbox"/> N/A	
1.	Roads damaged	Location shown on site map	Roads adequate N/A
	Remarks _____		

B. Other Site Conditions			
Remarks _____			

VII. LANDFILL COVERS Applicable ✓ N/A			
A. Landfill Surface			
1.	Settlement (Low spots) Areal extent _____ Remarks _____	Location shown on site map Depth _____	Settlement not evident
2.	Cracks Lengths _____ Remarks _____	Location shown on site map Widths _____ Depths _____	Cracking not evident
3.	Erosion Areal extent _____ Remarks _____	Location shown on site map Depth _____	Erosion not evident
4.	Holes Areal extent _____ Remarks _____	Location shown on site map Depth _____	Holes not evident
5.	Vegetative Cover Trees/Shrubs (indicate size and locations on a diagram) Remarks _____	Grass _____ Cover properly established	No signs of stress
6.	Alternative Cover (armored rock, concrete, etc.) Remarks _____	N/A	
7.	Bulges Areal extent _____ Remarks _____	Location shown on site map Height _____	Bulges not evident

8.	Wet Areas/Water Damage	Wet areas/water damage not evident	
	Wet areas	Location shown on site map	Areal extent _____
	Ponding	Location shown on site map	Areal extent _____
	Seeps	Location shown on site map	Areal extent _____
	Soft subgrade	Location shown on site map	Areal extent _____
	Remarks _____		
9.	Slope Instability	Slides	Location shown on site map No evidence of slope instability
	Areal extent _____		
	Remarks _____		
B. Benches	Applicable	N/A	
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)			
1.	Flows Bypass Bench	Location shown on site map	N/A or okay
	Remarks _____		
2.	Bench Breached	Location shown on site map	N/A or okay
	Remarks _____		
3.	Bench Overtopped	Location shown on site map	N/A or okay
	Remarks _____		
C. Letdown Channels	Applicable	N/A	
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)			
1.	Settlement	Location shown on site map	No evidence of settlement
	Areal extent _____	Depth _____	
	Remarks _____		
2.	Material Degradation	Location shown on site map	No evidence of degradation
	Material type _____	Areal extent _____	
	Remarks _____		
3.	Erosion	Location shown on site map	No evidence of erosion
	Areal extent _____	Depth _____	
	Remarks _____		

4.	Undercutting Areal extent _____ Remarks _____	Location shown on site map _____ Depth _____	No evidence of undercutting
5.	Obstructions Type _____ Location shown on site map _____ Size _____ Remarks _____	Areal extent _____	No obstructions
6.	Excessive Vegetative Growth Type _____ No evidence of excessive growth Vegetation in channels does not obstruct flow Location shown on site map _____ Remarks _____	Areal extent _____	
D. Cover Penetrations Applicable N/A			
1.	Gas Vents Properly secured/locked Evidence of leakage at penetration N/A Remarks _____	Active Functioning	Passive Routinely sampled Good condition Needs Maintenance
2.	Gas Monitoring Probes Properly secured/locked Evidence of leakage at penetration Remarks _____	Functioning	Routinely sampled Good condition Needs Maintenance N/A
3.	Monitoring Wells (within surface area of landfill) Properly secured/locked Evidence of leakage at penetration Remarks _____	Functioning	Routinely sampled Good condition Needs Maintenance N/A
4.	Leachate Extraction Wells Properly secured/locked Evidence of leakage at penetration Remarks _____	Functioning	Routinely sampled Good condition Needs Maintenance N/A
5.	Settlement Monuments Remarks _____	Located	Routinely surveyed N/A

E. Gas Collection and Treatment		Applicable	N/A
1.	Gas Treatment Facilities Flaring Thermal destruction Good condition Needs Maintenance Remarks _____		Collection for reuse
2.	Gas Collection Wells, Manifolds and Piping Good condition Needs Maintenance Remarks _____		
3.	Gas Monitoring Facilities (e.g., gas monitoring of adjacent homes or buildings) Good condition Needs Maintenance Remarks _____		N/A
F. Cover Drainage Layer		Applicable	N/A
1.	Outlet Pipes Inspected Remarks _____	Functioning	N/A
2.	Outlet Rock Inspected Remarks _____	Functioning	N/A
G. Detention/Sedimentation Ponds		Applicable	N/A
1.	Siltation Areal extent _____ Depth _____ Siltation not evident Remarks _____		N/A
2.	Erosion Areal extent _____ Depth _____ Erosion not evident Remarks _____		
3.	Outlet Works Remarks _____	Functioning	N/A
4.	Dam Remarks _____	Functioning	N/A

H. Retaining Walls		Applicable	N/A
1.	Deformations Horizontal displacement _____ Rotational displacement _____ Remarks _____	Location shown on site map	Deformation not evident
2.	Degradation Remarks _____	Location shown on site map	Degradation not evident
I. Perimeter Ditches/Off-Site Discharge		Applicable	N/A
1.	Siltation Areal extent _____ Remarks _____	Location shown on site map	Siltation not evident
2.	Vegetative Growth Vegetation does not impede flow Areal extent _____ Remarks _____	Location shown on site map	N/A
3.	Erosion Areal extent _____ Remarks _____	Location shown on site map	Erosion not evident
4.	Discharge Structure Remarks _____	Functioning	N/A
VIII. VERTICAL BARRIER WALLS		Applicable	✓ N/A
1.	Settlement Areal extent _____ Remarks _____	Location shown on site map	Settlement not evident
2.	Performance Monitoring Type of monitoring _____ Performance not monitored Frequency _____ Head differential _____ Remarks _____		Evidence of breaching

IX. GROUNDWATER/SURFACE WATER REMEDIES		✓Applicable	N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines		✓Applicable	N/A
1.	Pumps, Wellhead Plumbing, and Electrical ✓Good condition ✓All required wells properly operating Needs Maintenance N/A Remarks _____ _____ _____		
2.	Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances Good condition ✓Needs Maintenance Remarks Discharge line pigged by WLSSD in 2007. Four check valves in control house no longer seat properly. Valves must be		
3.	Spare Parts and Equipment Readily available Good condition Requires upgrade Needs to be provided Remarks Spare parts are not on-site. Spare parts not required unless ground water extraction system is activated		
B. Surface Water Collection Structures, Pumps, and Pipelines		✓Applicable	N/A
1.	Diversion and Collection Structures, Pumps, and Electrical Good condition Needs Maintenance Remarks DRAP implementation is resulting in the diversion of surface water from the historic source area. Drainage ditches		
2.	Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances Good condition Needs Maintenance ✓N/A Remarks _____ _____ _____		
3.	Spare Parts and Equipment ✓N/A Readily available Good condition Requires upgrade Needs to be provided Remarks _____ _____ _____		

replaced if
ground
water
extraction
system is
returned
to operation

appear to
be functioning
as intended.

C. Treatment System		<input checked="" type="checkbox"/> Applicable	N/A
1.	Treatment Train (Check components that apply) Metals removal _____ Oil/water separation _____ Bioremediation _____ Air stripping _____ Carbon adsorbers _____ Filters _____ Additive (e.g., chelation agent, flocculent) _____ Others _____ Good condition _____ Needs Maintenance _____ Sampling ports properly marked and functional _____ Sampling/maintenance log displayed and up to date _____ Equipment properly identified _____ Quantity of groundwater treated annually <u>11 - 14 MG</u> Quantity of surface water treated annually _____ Remarks <u>Extracted ground water is discharged directly to the sanitary sewer for treatment by the local POTW</u>		
2.	Electrical Enclosures and Panels (properly rated and functional) N/A <input checked="" type="checkbox"/> Good condition Needs Maintenance Remarks _____		
3.	Tanks, Vaults, Storage Vessels N/A <input checked="" type="checkbox"/> Good condition Proper secondary containment Needs Maintenance Remarks <u>Limited to four sumps in the ground water extraction trench. All sumps are in good condition</u>		
4.	Discharge Structure and Appurtenances N/A <input checked="" type="checkbox"/> Good condition Needs Maintenance Remarks _____		
5.	Treatment Building(s) N/A <input checked="" type="checkbox"/> Good condition (esp. roof and doorways) Needs repair Chemicals and equipment properly stored Remarks _____		
6.	Monitoring Wells (pump and treatment remedy) <input checked="" type="checkbox"/> Properly secured/locked <input checked="" type="checkbox"/> Functioning <input checked="" type="checkbox"/> Routinely sampled <input checked="" type="checkbox"/> Good condition <input checked="" type="checkbox"/> All required wells located Needs Maintenance N/A Remarks _____		
D. Monitoring Data			
1.	Monitoring Data <input checked="" type="checkbox"/> Is routinely submitted on time <input checked="" type="checkbox"/> Is of acceptable quality		
2.	Monitoring data suggests: <input checked="" type="checkbox"/> Groundwater plume is effectively contained <input checked="" type="checkbox"/> Contaminant concentrations are declining		

D. Monitored Natural Attenuation	
1. Monitoring Wells (natural attenuation remedy)	Properly secured Leaked Functioning Routinely sampled Good condition All required wells located Needs Maintenance <input checked="" type="checkbox"/> N/A
Remarks	While natural attenuation was not selected as the remedy, analytical data suggests it is occurring
X. OTHER REMEDIES	
If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction. Alternate water supply (water main and associated connections)	
XI. OVERALL OBSERVATIONS	
A. Implementation of the Remedy	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). See Five-Year Review Report
B. Adequacy of O&M	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. See Five-Year Review Report

is owned
and
operated
by the
city of
Hermantown

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future.

No issues or observations in cost or scope of O&M or repairs suggest protectiveness may be compromised in the future.

Check valves in the control house must be replaced if the ground water extraction system is returned to operation

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

Not Applicable. Ground water extraction system has been turned off. Ground water monitoring has been modified and is occurring in accordance with the Trial Ground Water Extraction System Shut-Down Plan.



New Storage area on north side of property.



New Storage area on north side of property.



New Storage area on north side of property.



MW-17 well nest at the corner of Rose Road and Hwy 53.



New Storage area on north side of property.



Manhole # 3: showing two pumps installed in manhole.



View of area on the corner of Rose Road and Hwy 53.



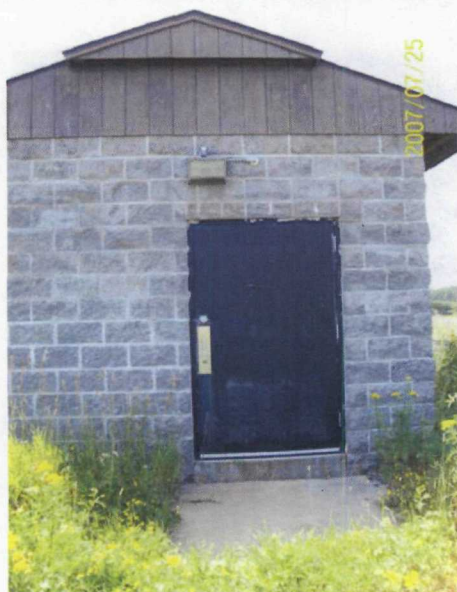
Four Drums staged outside treatment building.



Treatment Building: south side of building.



Treatment Building: Pump House Controls



Treatment Building: Entrance door.



Treatment Building: Process Piping



Treatment Building: Process Piping



Fill added to historic source area.



Drum near power pole adjacent to Hwy 53 entrance.



Fill added to historic source area.



MPCA - 4A & MPCA - 4B: Height of well casings have already been increased. Photo shows after fill has been added around wells.



Fill added to the historic source area.



Fill added to historic source area.



Drainage Ditch around historic source area. This area can be filled in. Fill has been already added.



Fill added to historic source area.



Drainage Ditch around historic source area. This area can be filled in. Fill has been already added.



MPCA - 2A : Raised casing - needs locking hasp.



Drainage Ditch around historic source area. This area can be filled in. Fill has been already added.



Drainage Ditch with Manhole # 3.



Drainage Ditch



Drainage ditch and Manhole # 2.



Drainage Ditch



MW - 3 well nest



Drainage ditch



Culvert Beneath US Highway 53 – Water can flow freely.



MW – 3A: New well installed.



Culvert – From Above



Manhole # 1 : Elevation will be raised 4 – 6 feet as part of DRAP.



Final grade reference for MW-14 well nest: Southwest corner of building adjacent to MW-14 well nest.



MW-14 well nest with raised casings. Approximately 5-6 feet of fill will be added.



MW-14 well nest with raised casings.
Approximately 5-6 feet of fill will be added.